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ABSTRACT

Is inequality largely the result of the Industrial Revolution? Or, were pre-industrial incomes and life expectancies as unequal as they are today? For want of sufficient data, these questions have not yet been answered. This paper infers inequality for 14 ancient, pre-industrial societies using what are known as social tables, stretching from the Roman Empire 14 AD, to Byzantium in 1000, to England in 1688, to Nueva España around 1790, to China in 1880 and to British India in 1947. It applies two new concepts in making those assessments -- what we call the inequality possibility frontier and the inequality extraction ratio. Rather than simply offering measures of actual inequality, we compare the latter with the maximum feasible inequality (or surplus) that could have been extracted by the elite. The results, especially when compared with modern poor countries, give new insights in to the connection between inequality and economic development in the very long run.

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1. Good Questions, Bad Data?

Is inequality largely a byproduct of the Industrial Revolution? Or, were pre-industrial incomes and life expectancies as unequal as they are today? How does inequality in today's least developed, agricultural countries compare with that of ancient societies dating back to the Roman Empire? Did some parts of the world always have greater income inequality than others? Was inequality augmented by colonization? These questions have not been answered yet, for want of sufficient data. Our effort to gather these data has not been easy, even though we were well warned of the pitfalls facing any attempt to explore pre-industrial income gaps between rich and poor.

Simon Kuznets was very skeptical of attempts to compare income inequalities across countries when he was writing in the 1970s. In his view, the early compilations assembled by the International Labor Organization and the World Bank referred to different population concepts, different income concepts, and different parts of the national economy. To underline his doubts, Kuznets once asked (rhetorically) at a University of Wisconsin seminar "Do you really think you can get good conclusions from bad data?" Economists with interest in inequality are indebted to Kuznets for his sage warning.[1] We are even more indebted to Kuznets for violating his own warning when, earlier in his career, he famously conjectured about his Kuznets Curve based on a handful of very doubtful inequality observations. His 1954 Detroit AEA Presidential Address mused on how inequality might have risen and fallen over two centuries, and theorized about the sectoral and demographic shifts that might have caused such movements. Over

[1] His Wisconsin seminar paper became a classic (Kuznets 1976).

the last half century, economists have responded enthusiastically to his postulated Kuznets Curve, searching for better data, better tests, and better models.

As we have said, Kuznets based his hypothetical Curve on very little evidence. The only country for which he had good data was the United States after 1913, on which he was the data pioneer himself. Beyond that, he judged earlier history from tax data taken from the United Kingdom since 1880 and Prussia since 1854 (1955, p. 4). For these three advanced countries, incomes had become more unequal between the late nineteenth century and the 1950s. He presented no data at all regarding earlier trends, yet bravely conjectured that "income inequality might have been widening from about 1780 to 1850 in England; from about 1840 to 1890, and particularly from 1870 on in the United States; and from the 1840's to the 1890's in Germany" (1955, p. 19). For poor, pre-industrial countries, he had only household surveys for India 1949-1950, Sri Lanka 1950, and Puerto Rico 1948 (1955, p. 20). These are all bad data judged by the standards Kuznets himself applied in the 1970s. They are also bad data judged by the modern World Bank standards since those three surveys from the mid-20th-century would now be given low grades on the Deininger-Squire scale assessing the quality of income distribution data (Deininger and Squire, 1996: pp. 567-71). Meanwhile, world inequalities have also changed. The convergence of incomes within industrial countries that so impressed Kuznets has been reversed, and the gaps have widened again.

We have reason, therefore, to ask anew whether income inequality was any greater in the distant past than it is today. This paper offers five conjectures about inequality patterns during and since ancient pre-industrial times:

(1) Income inequality must have risen as hunter-gathers slowly evolved into ancient agricultural settlements with surpluses above subsistence. Inequality rose further as economic development in these early agricultural settlements gave the elite the opportunity to harvest those rising surpluses.

(2) Yet, the evidence suggests that the elite failed to exploit their opportunity fully since income inequality did not rise anywhere near as much as it could have. While potential inequality rose steeply over the very long run, actual inequality rose much less.

(3) In ancient pre-industrial times, inequality was driven largely by the gap between the rural poor at the bottom and the landed elite at the top. The distribution of income among the elite themselves, and their share in total income, contributed far less to overall inequality, and never consistently.

(4) Ancient pre-industrial inequality seems to have been lower in East Asia than it was in the Middle East, Europe, or the world as settled by Europeans, suggesting long period persistence in region-specific distributions.

(5) While there is little difference in conventionally measured inequality between modern and ancient pre-industrial societies, there are immense differences in two other, less conventional, dimensions. First, the share of potential inequality actually achieved today is far less than was true of pre-industrial times. Second, life expectancy inequality was far greater two centuries ago than it is today. The decline in survival inequality in the twentieth century has contributed mightily to the convergence of lifetime incomes in the world economy.

Our data are subject to all the concerns that bothered Kuznets, other economists, and the present authors. Our income inequality statistics exploit fragile measures of annual household income, without adjustment for taxes and transfers, life-cycle patterns, or household composition. None of our ancient inequality observations would rate a “1” on the Deininger-Squire scale. Yet, like Gregory King in the 1690s and Simon Kuznets in the 1950s, we must start somewhere. Section 2 begins by introducing some new concepts that we use for the analysis -- the *inequality possibility frontier* and the *inequality extraction ratio*, measures of the extent to which the elite extract the maximum feasible inequality. These new measures open the door to fresh interpretations of inequality in the very long run. The next section presents our ancient inequality evidence. Section 4 examines income gaps between top and bottom, and the extent to which observed inequality change over the very long run is driven by those gaps as opposed to the distribution of income among those at the top or the top’s income share. Section 5 explores how the stylized facts are changed when conventional annual income measures are replaced by lifetime income measures. We conclude with a research agenda.

2. The Inequality Possibility Frontier

The workhorse for our empirical analysis of ancient inequalities is a concept we call the *inequality possibility frontier*. While the idea is simple enough, it has surprisingly been overlooked by past authors. Suppose that each society, including ancient non-industrial societies, has to distribute income in such a way as to guarantee subsistence minimum for its poorer classes. The remainder of the total income is the surplus that is shared among the richer classes. When average incomes are very low, and barely above the subsistence minimum, the surplus is small. Under those primitive conditions, the members of the upper class will be few, and the level of inequality will be quite modest. But as average incomes increase with economic progress, this constraint on inequality is lifted; the surplus increases, and the maximum possible inequality compatible with that new, higher, average income is greater. In other words, the maximum attainable inequality is an increasing function of mean overall income. Whether the elite fully exploit that maximum, and whether some trickle-down allows the subsistence minimum to rise, is, of course, another matter entirely.

To fix ideas intuitively, suppose that a society consists of 100 people, 99 of whom are lower class. Assume further that the subsistence minimum is 10 units, and total income 1050 units. The 99 members of the lower class receive 990 units of income and the only member of the upper class receives 60. The Gini coefficient corresponding to such a distribution will be only 4.7 percent. If total income improves over time to 2000 units, then the sole upper class member will be able to extract 1010 units, and the corresponding Gini coefficient will leap to 49.5 percent. If we chart the locus of such maximum possible Ginis on the vertical axis against mean income levels on the horizontal axis, we obtain the *inequality possibility frontier* (IPF).[2] Note also that by virtue of the fact that any progressive transfer must reduce inequality measured by the Gini coefficient, we know that a less socially-segmented society must result in a lower Gini.[3] Thus, IPF is indeed a *frontier*.

[2] The IPF concept was first introduced in Milanovic (2006).

[3] The reader can verify this by letting one subsistence worker's income rise above subsistence to 20, and by letting the richest person's income be reduced to 1000. The new Gini would be 49.49.

The *inequality possibility frontier* can be derived more formally. Define s=subsistence minimum, μ=overall mean income, N=number of people in a society, and ε=proportion of people belonging to a (very small) upper class. Then the mean income of upper class people (y_h) will be

$$y_h = \frac{\mu N - sN(1-\varepsilon)}{\varepsilon N} = \frac{1}{\varepsilon}[\mu - s(1-\varepsilon)] \qquad (1)$$

where we assume as before that the (1-ε)N people belonging to lower classes receive subsistence incomes.

Once we document population proportions and mean incomes for both classes, and assume further that all members in a given class receive the same income,[4] we can calculate any standard measure of inequality from the distribution data. Here we shall derive the IPF using the Gini coefficient.

The Gini coefficient for *n* social classes whose mean incomes (y) are ordered in an ascending fashion ($y_j > y_i$), with subscripts denoting social classes, can be written as in equation (2)

$$G = \sum_{i=1}^{n} G_i p_i \pi_i + \frac{1}{\mu} \sum_{i}^{n} \sum_{j>i}^{n} (y_j - y_i) p_i p_j + L \qquad (2)$$

where π_i=proportion of income received by *i*-th social class, p_i=proportion of people belonging to *i*-th social class, G_i=Gini inequality among people belonging to *i*-th social class, and L=the overlap term which is greater than 0 only if there are members of a lower social class (*i*) whose incomes exceed that of some members of a higher social class (*j*). The first term on the right-hand side of equation (2) is the within component (part of total inequality due to inequality within classes), the second term is the between

[4] This is already assumed for the lower classes, but that assumption will be relaxed later for the upper classes.

component (part of inequality due to differences in mean incomes between classes) and L is, as already explained, the overlap term.

Continuing with our illustrative case, where all members of the two social classes (upper and lower) have the mean incomes of their respective classes, equation (2) simplifies to

$$G = \frac{1}{\mu}(y_j - y_i)p_i p_j \qquad (3)$$

Substituting (1) for the income of the upper class, and *s* for the income of lower class, as well as their population shares, (3) becomes

$$G^* = \frac{1}{\mu}\left[\frac{1}{\varepsilon}\left(\mu - s(1-\varepsilon)\right) - s\right]\varepsilon(1-\varepsilon) \qquad (4)$$

where G* denotes the maximum feasible Gini coefficient for a given level of mean income (μ). Rearranging terms in (4), we simplify

$$G^* = \frac{1-\varepsilon}{\mu}\left[\left(\mu - s(1-\varepsilon)\right) - s\varepsilon\right] = \frac{1-\varepsilon}{\mu}(\mu - s) \qquad (5)$$

Finally, if we now express mean income as a multiple of the subsistence minimum, $\mu=\alpha s$ (where $\alpha \geq 1$), then (5) becomes

$$G^* = \frac{1-\varepsilon}{\alpha s}s(\alpha - 1) = \frac{\alpha - 1}{\alpha}(1-\varepsilon) \qquad (6)$$

Equation (6) represents our final expression for the maximum Gini which will chart IPF as α is allowed to increase from 1 to higher values. For example, when α=1 (all individuals receive the same income), (6) reduces to 0 (as we would expect), while when α=2, the maximum Gini becomes 0.5(1-ε). Let the percentage of population that belongs to the upper class be one-tenth of 1 percent (ε=0.001). Then for α=2, the maximum Gini will be 49.95 (expressed as a percentage).[5] The hypothetical IPF curve generated for α values ranging between 1 and 5 is shown in Figure 1.

[Figure 1 about here]

The derivative of the maximum Gini with respect to mean income (given a fixed subsistence) is

$$\frac{dG^*}{d\alpha} = \frac{1-\varepsilon}{\alpha}\left(1-\frac{\alpha-1}{\alpha}\right) = \frac{1-\varepsilon}{\alpha^2} > 0 \tag{7}$$

In other words, the IPF curve is increasing and concave. Using (7), one can easily calculate the elasticity of G* with respect to α as 1/(α-1). That is, the percentage change in the maximum Gini in response to a given percentage change in mean income is less at higher levels of mean income.

The *inequality possibility frontier* depends on two parameters, α and ε. In the illustrative example used here, we have assumed that ε=0.1 percent. How sensitive is our Gini maximum to this assumption? Were the membership of the upper class even more exclusive, consisting of (say) 1/50th of one percent of population, would the maximum Gini change dramatically? Taking the derivative of G* with respect to ε in equation (6), we get

$$\frac{dG^*}{d\varepsilon} = \frac{1-\alpha}{\alpha} < 0 \tag{8}$$

Thus, as ε falls (the club gets more exclusive), G* rises. But is the response big? Given the assumption that mean income is twice subsistence and that the share of the top income class is ε=0.001, we have seen that the maximum Gini is 49.95. But if we assume instead that the top income group is cut to one-fifth of its previous size (ε=1/50 of one

[5] As the percentage of people in top income class tends toward 0, G* tends toward (α-1)/α. Thus, for example, for α=2, G* would be 0.5 (or 50 percent).

percent), the Gini will increase to 49.99, or hardly at all. G* is, of course, bounded by 50. For historically plausible parameters, the IPF Gini is not very sensitive to changes in the size of the top income class.

The assumption that all members of the upper class receive the same income is convenient for the derivation of the IPF, but would its relaxation make a significant difference in the calculated G*? To find out, we need to go back to the general Gini formula given in (2). The within-group Gini for the upper class will no longer be equal to 0.[6] The overall Gini will increase by $\varepsilon\pi_h G_h$ where *h* is the subscript for the upper (high) class. The income share appropriated by the upper class is

$$\pi_h = 1 - \frac{1-\varepsilon}{\alpha}$$

and the increase in the overall G* will therefore be

$$\Delta G^* = G_h\left(1 - \frac{1-\varepsilon}{\alpha}\right)\varepsilon \quad . \tag{9}$$

This increase is unlikely to be substantial. Consider again our illustrative example where α=2 and ε=0.001. The multiplication of the last two terms in (9) equals 0.0005. Even if the Gini among upper classes is increased to 50, the increase in the overall Gini (ΔG*) will be only 0.025 Gini points. We conclude that we can safely ignore the inequality among the upper class in our derivation of the maximum Gini. Inequality among the upper class is unlikely to make much difference since the assumed size of the top income group is so small to start with. Thus, we think within-group inequality can be safely ignored for IPF estimates since almost the entire inequality is due to the between-

[6] For the lower class, within-group inequality is zero by assumption since all of its members are taken to live at subsistence.

group Gini component.[7] This inference should not imply a disinterest in actual distribution at the top; indeed, we will assess the empirical support for it in section 4.

3. Social Tables and Inequality Measures

Income distribution data based on household surveys are, of course, unavailable for pre-industrial societies. The earliest household surveys of income and expenditures date from the late eighteenth century in England and the mid nineteenth century in other countries. We believe that the best estimates of ancient inequalities can be obtained from what are called *social tables* (or, as William Petty (1676) called it more than three centuries ago, *political arithmetick*) where various social classes are ranked from the richest to the poorest with their estimated population (family or household head) shares and average incomes. Social tables are particularly useful in evaluating ancient societies where classes were clearly delineated and the differences in mean incomes between them were substantial. Theoretically, if class alone determined one's income, and if differences in income within classes were small, then all inequality would be explained by the between-class inequality. One of the best examples of social tables is offered by Gregory King's famous estimates for England and Wales in 1688 (Barnett 1936; Lindert and Williamson 1982). King's list of classes summarized in Table 1 is fairly detailed (31 social classes). King (and others listed in Table 1) did not report inequalities within each social class so we cannot identify within-class inequality for 1688 England and Wales or for any other of the Table 1 observations. However, within-class inequalities can be

[7] Moreover, in the empirical work below, we shall be using mean incomes of social classes to calculate the estimates of ancient inequalities, thus making an assumption equivalent to the one made in the derivation of the inequality possibility frontier.

roughly gauged by calculating two Gini values: a lower bound Gini1 which estimates only the between-group inequality and assumes within-group or within-social class inequality to be zero; an upper bound Gini2 which estimates the maximum inequality that is compatible with the grouped data from social tables assuming that all individuals from a higher social group are richer than any individual from a lower social group. In other words, where class mean incomes are such that $y_j > y_i$, it also holds true that $y_{kj} > y_{mi}$ for all members of group *j*, where *k* and *m* are subscripts that denote individuals. Thus, in addition to the between-class inequality component, Gini2 includes some within-class inequality (see equation 2), but under the strong assumption that mean incomes for all members of a given social class are poorer or richer than those respectively above or below them. This strong assumption is unlikely to be fulfilled in any actual social table, but it allows us to move beyond an accounting limited only to between-class inequality.[8] In the empirical work that follows, we shall depend almost entirely on social tables or tax census data obtained from secondary sources, including some estimates of our own. Detailed explanations for each country's social table are provided in the Appendix 1.

[Table 1 about here]

Table 1 lists 14 ancient pre-industrial societies for which we have calculated inequality statistics.[9] These societies range from early first-century Rome (Augustan Principate) to India just prior to its independence from Britain. Assuming with Angus

[8] Gini2 is routinely calculated when published income distribution data are only reported as fractiles of the population and their income shares are the only data given. In that case, of course, any member of a richer group must have a higher income than any member of a lower group. This is unlikely to be satisfied when the fractiles are not income classes but rather social classes as is the case here. The Gini2 formula is due to Kakwani (1980).

[9] Joseph Massie's famous social tables for 1759 England and Wales are not used here since he did not give them in a form consistent with our needs. In addition, we excluded 1752 Jerez (Andalusia) since it was primarily an urban observation. In the near future, we expect to augment the sample by adding 1861 Chile, 1924 Java, late Tokugawa and early Meiji Japan, 1427 Tuscany, 1788 France, Tsarist Russia and others.

Maddison an annual subsistence minimum of \$PPP 400 per capita,[10] and with GDI per capita ranging from about \$PPP 500 to \$PPP 2,000, then α would range from 1.3 to 5. A GDI per capita of \$PPP 2,000 is a level of income not uncommon today, and it would place 1732 Holland or 1801-03 England and Wales in the 40th percentile in the world distribution of countries by per capita income in the year 2000. With the possible exception of 1732 Holland and 1801-3 England, countries in our sample have average incomes that are roughly compatible with contemporary pre-industrial societies that have not yet started significant and sustained industrialization. The urbanization rate in our sample ranges from less than 10 to 45 percent (the latter, again, for Holland). Population size varies even more, from an estimated 983,000 in 1561 Holland to 350 million or more in India 1947 and China 1880. Finally, the number of social classes into which distributions are divided, and from which we calculate our Ginis, varies considerably. They number only three for 1784-99 Nueva España (comprising the territories of today's Mexico, Central America, Cuba and parts of the western United States) and 1880 China. In most cases, the number of social classes is in the double digits. The largest number is in Brazil, where the data from the 1872 Brazilian census include 813 occupations.

The estimated inequality statistics are reported in Table 2. The calculated Ginis display a very wide range: from 23.9 in 1880s China to 63.5 in 1784-99 Nueva España. The latter figure is higher than the inequality reported for some of today's most unequal countries like Brazil and South Africa (Table 2). The average Gini (using Gini2 where available, otherwise Gini1) from these 14 data points is 45.7, while the average Gini from the nine modern comparators is 43.3. These are only samples, of course, but there is very little difference on average between them, 45.7 (ancient) - 43.3 (modern) = 2.4. In

[10] All dollar data, unless indicated otherwise, are in 1990 Geary-Khamis PPPs.

contrast, there are very great differences within each sample: 58.8 (Brazil 2002) - 27.3 (Sweden 2000) = 31.5 among the modern comparators, while 63.5 (Nueva España 1784-99) - 24.5 (China 1880) = 39 among the ancient economies. In short, inequality differences within the ancient and modern samples is many times greater than the difference between them.

The Gini estimates are plotted in Figure 2 against the estimates of GDI per capita on the horizontal axis. They are also displayed against the *inequality possibility frontier* constructed on the assumption of a subsistence minimum of $PPP 400 (solid line).[11] In most cases, the calculated Ginis lie fairly close to the IPF. In terms of absolute distance, the countries falling farthest below the IPF curve are the most "modern" pre-industrial economies: England and Wales in 1688 and 1801-3, and Holland in 1732. The maximum possible Ginis in these cases range from 72 to 80 while the estimated Ginis are between 45 and 63. [12]

[Table 2 and Figure 2 about here]

If we used Maddison's subsistence level of $400, then four estimated Ginis would be significantly greater than the maximum Gini (at their level of income) implied by the IPF: three of these are based on data from India, and the fourth is from Nueva España.[13]

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[11] This is based on Maddison's (1998, p.12) assumed subsistence minimum. Note that a purely physiological minimum "sufficient to sustain life with moderate activity and zero consumption of other goods" (Bairoch 1993, p.106) was estimated by Bairoch to be $PPP 80 at 1960 prices. Using the US consumer price index to convert Bairoch's estimate to international dollars yields $PPP 355 at 1990 prices. Maddison's estimate allows in addition for expenses above the bare physiological minimum. Our minimum is also consistent with the World Bank absolute poverty line which is 1.08 per day per capita in 1993 $PPP (Chen and Ravallion 2007, p. 6). This works out to be about $PPP 365 per annum in 1990 international prices. Another justification for a subsistence minimum between $PPP 350 and 400 was recently provided by Becker, Philipson and Soares (2005), who, in calculation of multidimensional inequality (income times life expectancy), use a calibration to transform these two variables into one.

[12] Naples, with very low inequality, also lies deeply inside the Inequality possibility frontier.

[13] The Old Castille is also slightly above the IPF.

Recalling our definition of the IPF, these four cases can only be explained by one or more of these five possibilities: (i) a portion of the population cannot even afford the subsistence minimum, (ii) the actual ε is much smaller than the assumed $\varepsilon=0.001$, (iii) inequality within the rich classes is very large, (iv) our estimate of inequality is too high, and/or (v) the subsistence minimum is overestimated. We have already analyzed and dismissed the first three possibilities. The fourth possibility is unlikely: since our estimates of inequality are based only on a few classes, they are likely to be biased downwards, not upwards. The last possibility offers the more likely explanation. It could well be that the subsistence minimum was less than $PPP 400 for some societies.[14] In particular, this is likely to be the case for subtropical or tropical regions where calorie, housing and clothing needs are considerably less than those in temperate climates. Indeed, in his pioneering study of world incomes, Colin Clark (1957, pp. 18-23) distinguished between international units (the early PPP dollar) and oriental units, the dollar equivalents which presumably hold for Asia and other poor areas but not for the rest of the world. If the true subsistence minimum is less than Maddison's assumed value of $PPP 400, the IPF would move upwards (see the new IPF shown by a broken line in Figure 2). Thus, the average income of $PPP 800 would no longer be equivalent to 2 subsistence minima ($\alpha=2$) but, assuming the subsistence minimum of $PPP 300, the mean income of $PPP 800 would amount to $\alpha=2\frac{2}{3}$. If the IPF is drawn under the $s=300$ assumption, it shifts the frontier upwards enough to encompass at or below it all our estimated inequalities, with the possible (and modest) exceptions of Moghul India and Nueva España.

[14] Another possibility is that our Maddison-based estimates of mean incomes for these four cases are too low. If that was true, all four points should be moved horizontally to the right, thus falling inside the IPF.

How do country inequality measures compare with the maximum feasible Ginis at their estimated income levels? Call the ratio between the actual (measured using Gini2) and the maximum feasible inequality the *inequality extraction ratio*, indicating how much of the maximum inequality was actually extracted: the higher the *inequality extraction ratio*, the more (relatively) unequal the society.[15] The median ratio in our sample is 94 percent, the mean 102 percent. The countries with the lowest ratios are 1811 Naples and 1688 England and Wales (60-62 percent).

The *inequality possibility frontier* allows us to better situate these estimates of ancient inequality in modern experience. Using the same framework that we have just applied to ancient societies, the bottom panel of Table 2 provides estimates of inequality in several contemporary societies. Brazil and South Africa have often been cited as examples of extremely unequal societies, both driven by long experience with racial discrimination, tribal power and regional dualism. Indeed, both countries display Ginis comparable to those of the most unequal pre-industrial societies included in our sample. But Brazil and South Africa are several times richer than the richest pre-industrial society in our sample. Consequently, the maximum feasible inequality is much higher than anything we have seen in our ancient sample. Thus, the elite in both countries have extracted only about two-thirds of their maximum feasible inequality, and their inequality extraction ratios are about the same as what we found for the most *egalitarian* ancient societies (1688 England and Wales, and 1811 Kingdom of Naples).

In the year 2000, countries near the world median GDI per capita (about \$PPP 3,500) or near the world mean population-weighted GDI per capita (a little over \$PPP

[15] The term "relative" is used here, *faute de mieux*, to denote conventionally calculated inequality in relation to maximum possible inequality at a given level of income; not whether the measure of inequality itself is relative or absolute.

6,000), had maximum feasible Ginis of 89 and 93 respectively. The median Gini in today's world is about 35, having thus extracted just a bit over a third of feasible inequality, vastly less than did ancient societies. Using this measure, China's present *inequality extraction ratio* is 47 percent, while that for the United States is 41 percent, and that for Sweden 28 percent. Only in the extremely poor countries today, with GDI per capita less than $PPP 600, do actual and maximum feasible Ginis lie close together (2003 Nigeria, 2004 Congo D. R., and 2000 Tanzania). Thus, while inequality in historical pre-industrial societies is equivalent to that of today's pre-industrial societies, ancient inequality was *much* greater when expressed in terms of maximum feasible inequality. Compared with the maximum inequality possible, today's inequality is *much* smaller than that of ancient societies.

Our new measure of inequality (the *inequality extraction ratio*) may possibly reflect more accurately societal inequality, and the role it plays, than does any actual measure. This new view of inequality may be more pertinent for the analysis of power in both ancient and modern societies. For example, Tanzania (denoted TZA in Figure 3) with a relatively low Gini of 35 may be less egalitarian than it appears since measured inequality lies so close to (or indeed above) its *inequality possibility frontier* (Table 2 and Figure 3). On the other hand, with a much higher Gini of almost 48, Malaysia (MYS) has extracted only about one-half of maximum inequality, and thus is farther away from the IPF.

[Table 2 and Figure 3 about here]

Another implication of our approach is that it considers jointly inequality and development. As a country becomes richer, its feasible inequality expands. Consequently, if recorded inequality is stable, the *inequality extraction ratio* must fall; and even if recorded inequality goes up, the ratio may not. This can be seen in Figure 4 where we plot the inequality extraction ratio against GDI per capita. Thus, the social consequences of increased inequality may not entail as much relative impoverishment, or as much perceived injustice, as might appear if we looked only at the recorded Gini. This logic is particularly compelling for poor and middle-income countries where increases in income push the maximum feasible inequality up relatively sharply, since the IPF curve is concave. The farther a society rises above the subsistence minimum, the less will economic development lift its *inequality possibility frontier*, and thus the *inequality extraction ratio* will be driven more and more by the rise in the Gini itself. This is best illustrated by the United States where the maximum feasible inequality already stands at a Gini of 98.2. Economic development offers this positive message: the *inequality extraction ratio* will fall with GDI per capita growth even if measured inequality remains constant. However, economic decline offers the opposite message: that is, a decline in GDI per capita, like that registered by Russia in the early stages of its transition from Communism, drives the country's maximum feasible inequality down. If the measured Gini had been stable, the *inequality extraction ratio* would have risen. If the measured Gini rose (as was indeed the case in Russia), the *inequality extraction ratio* would have risen even more sharply. Rising inequality may be particularly socially disruptive under these conditions.

[Figure 4 around here]

4. Looking at Different Parts of the Income Distribution

How much of the inequality observed in ancient societies can be explained by the economic distance between the rural landless poor at the bottom and the rich landed elite at the top? How much can be explained by the distribution among the elite at the top? How much by the share of that elite in the total?

Life at the Top: Income Distribution among the Elite

An impressive amount of recent empirical work has suggested that the evolution of the share of the top 1 percent yields a good approximation to changes in the overall income distribution in modern industrial societies (Piketty 2003, 2005; Piketty and Saez 2003, 2006; Atkinson and Piketty forthcoming). These studies find that most of the action takes place at the top of the income distribution pyramid and that differences in the top 1 percent income share account for much of the differences in overall inequality. These top share studies have also been performed on poor pre-modern India (since 1922: Banerjee and Piketty 2005), Indonesia (since 1920: Leigh and van der Eng 2006) and Japan (since 1885: Moriguchi and Saez 2005), but it is important to stress that they do not *find* this result, but rather *assume* it. So, are differences in the share of the top 1 percent also a good proxy for differences in overall income distribution in ancient pre-industrial societies?

The share of top 1 percent is estimated here under the assumption that top incomes follow a Pareto distribution. Our approach is basically the same as that recently used by Atkinson (forthcoming) and by others writing before him (see the references in

Atkinson). The estimation procedure is explained in detail in Appendix 3 where several caveats are listed since our social tables are different from the usual income distribution data sources.

Table 3 reports two key results: the estimated income share of the top 1 percent of recipients, and the cut-off point, that is the income level (relative to the mean) where the top one percent of recipients begins. The countries are listed in descending order according to the top 1 percent share. In sharp contrast with modern studies, the correlation between the top 1 percent share and the Gini is negative, small (-0.13), and statistically insignificant. This implies that differences in the top percentile share do not reflect differences in overall inequality very well, a result consistent with what we report on the average income to rural wage ratio below. Consider, for example, the Roman and Byzantine empires. Their estimated Ginis are very similar (39.4 and 41) but the top percentile share in Byzantium (30.6, the highest in our sample) is almost twice as great as in Rome (16.1). Consider another top-heavy society like China in 1880 where the top percentile share of 21.3 is second only to Byzantine 1000, but where the Gini is the lowest in the sample (24.5).

[Table 3 and Figure 5 about here]

The location of the cut-off point -- where the top percentile begins -- tells us a lot about the organization of societies. Figure 5 displays the top percentile share and the cut-off point (relative to mean income). At one end of the spectrum is the Byzantine Empire with a very rich top one percent, but also with an unusually low cut-off point. This would seem to indicate the absence of a middle class, that is, of those who would normally fill in the “space” between the mean income and (say) an income 3 to 4 times greater than the mean. The results for China display the same pattern.[16] On the other hand, the top percentile was very rich in the Roman Empire (16.1 percent of total income), but the cut-off point was very high too: 12.4 times the mean. This suggests a Roman income distribution with a long tail of rich people such that the 2nd-5th percentiles were also quite rich. This interpretation is supported by Figure 6 which shows the empirical income distributions and the estimated top percentile share calculated using the Pareto interpolation (see the dashed line).[17] While the income share after the first, and up to the 4th and the 5th percentile in Byzantium rises very slowly, the line rises more steeply in Rome, indicating that Romans in these percentiles were relatively wealthy. For comparative purposes, we also show the English 1801-3 data where the top 1 percent share, as well as the steepness of the line after the top percentile, are similar to those of Rome. It seems that the main difference among the very rich in Rome 14 and England 1801-3 was that the people just below the very top of the income pyramid were, relative to the mean, somewhat less rich in England than in Rome. Finally, notice that in all three cases, the top 5 percent of income recipients received between 30 and just over 40 percent of total income. In contrast, the top 5 percent received about a quarter of total income in modern United States and United Kingdom, while the share is 27 percent in modern Chile and a third in Brazil.

Table 3 also reports several modern comparators. In all cases but one (Mexico), their top 1 percent share is less, and for most cases, much less, than that estimated for our

[16] The Chinese result is driven in part by the available data which focus on the income of Chinese gentry, the top 2 percent of the population.

[17] Note that the high intercept of the line indicates a very high income share of the very top (people even richer than the top 1 percent).

sample of ancient societies. The low top 1 percent share combined with a low cut-off point (characteristic of advanced societies) betokens a distribution where, first, the richest 1 percent are not extravagantly rich (in contrast with the American Bill Gates or the Roman Marcus Licinus Crassus), and where, second, they are not very different from the rest of the population. Since we have already noted that Gini coefficients between the ancient and contemporary poor societies are not very different, this difference in the average top 1 percent shares between the ancient and modern implies that the link between top income share and overall inequality is not very strong among ancient societies.

Life at the Bottom: The Unskilled Rural Wage Relative to Average Income

For eleven of the fourteen countries in our ancient inequality sample, we can measure the economic distance between the landed elite and landless labor by computing the ratio of average family income (or average income per recipient, y) to that of landless, unskilled rural laborer (w). Figure 7 plots the relation between the overall Gini and the y/w ratio (Appendix 2).[18] The simple bivariate correlation is positive (standard errors in parentheses):

$$\text{Gini} = \underset{(4.83)}{29.79} + \underset{(3.04)}{6.27}\ y/w, \quad R^2 = 0.51 \qquad (n = 11)$$

The estimated relationship also implies an elasticity of the Gini with respect to the y/w ratio of 0.4. For every 10 percent increase in y/w, the Gini rose by 4 percentage points. Low measured inequalities in China 1880 and Naples 1811 (Ginis of 24.2 and 28.3) were consistent with small gaps between poor rural laborers and average incomes (y/w of 1.32

[18] This simple y/w index has been shown to be a good proxy for inequality among nineteenth and twentieth century poor economies (Williamson 1997, 2002).

and 1.49), or with a rural wage two-thirds to three-quarters of average income. High measured inequalities in Nueva España 1784-99 and England 1801-03 (Ginis of 63.5 and 51.5) were consistent with large gaps between poor rural laborers and average incomes (y/w of 2.94 and 4.17), or with a rural wage only one-quarter to one-third of average income. There appears to be only one true outlier to the otherwise tight relationship in Figure 7, British India in 1947. Still, the overall relationship does suggest that the gap between poor landless labor and the landed elite, whose incomes raise the average considerably, drives the Gini, not conditions at the top.

5. Unequal Life Expectancy and Lifetime Incomes

Thus far, this paper has followed convention by considering inequality of annual income. Yet, differences in the ability to consume should be gauged by lifetime income, not just annual income. The fact that some die much younger than others matters in gauging inequality, and it matters even more if morbidity and mortality are correlated, so that short lives are also low quality lives. How are comparisons between ancient and modern pre-industrial societies affected when we adjust for inequality in life expectancy?

We are interested in two concepts of life expectancy inequality: inequality in group survival rates, and inequality in individual survival rates. The first speaks to debates over the injustice of the rich living longer, while the second speaks to debates about the distribution of individual income and consumption. We think it is useful to measure historical movements in both kinds of life expectancy inequality, even without trying to tote up lifetime consumption levels.

Public interest in group survival rates tends to focus on differences between nations, social classes, and genders.[19] The difference in average survival between nations first rose and then fell over the last five hundred years. Before the sixteenth century, the average life span from birth was in the 21-29 year range the world over. Subsequently, western Europeans began to undergo an increase in life spans beyond 30 years while the rest of the world continued to die younger. This gap between longer-living rich countries and others continued to widen until the early twentieth century, thus causing world lifetime income inequality to rise more steeply than world annual income inequality. Over the past century, the life span gap between poor and rich countries has narrowed dramatically. Despite current concern about infectious diseases in poor countries, the fact is that spectacular progress has already been made there.

The resulting transformation in international inequalities is illustrated by Figure 8, which plots average life expectancies at birth (e_0) against GDP per capita. The two e_0 curves with black markers trace out long histories for England and Wales (later, the United Kingdom) since the late sixteenth century and France since the early eighteenth century. British and French citizens, and those in the rest of Western Europe, were, of course, much richer and lived much longer than their distant ancestors. The same has also been true of the Japanese since the early nineteenth century, even though they have always lived longer than Western Europeans at similar incomes. The distinction between

[19] On the gender front, we will only note that since about 1800, females have outlived males throughout the world. Before then, the gender life balance could tip either way. Males outlived females in some, but not all, of the pre-1800 averages for China, Japan, England, and Scandinavia. The global shift toward relatively longer-lived females is probably explained largely by the decline in female infanticide and in maternal deaths during childbirth.

shifts in the e_0 curve in Figure 8 and movements along it is important.[20] It is far harder to argue that shifts in the curve are driven by improvements in living standards than for movements along it (Preston 1980; Williamson 1984). While we know a great deal about the connections between individual living standards and longevity along the e_0 curve (Fogel 2004), we know far less about the public health forces accounting for the shift in the e_0 curve.

The most dramatic historical shift in international survival rates, however, has taken place in today's developing countries, seven of which are portrayed in Figure 8. People in today's poor countries live much longer than did Western Europeans before the twentieth century, at comparable income levels. For example, at the end of the twentieth century China had an average life expectancy of almost 70 years, compared with 47 years for the French in 1900 who received comparable real incomes. Similarly, Africans south of the Sahara survive a bit longer today (e_0 = 47 years, even including the impact of AIDS), than did the English in the early nineteenth century when they had the world's longest life spans (e_0 = 45 years). The global spread of better health care and public victories over many pathogens and parasites in the twentieth century created a dramatic life expectancy convergence between nations. Thus, we now live in a world where nations no longer differ anywhere near as much in life expectancies than they did a century ago. What separates nations today is the quality of life, not the length of life (Clark 2007, p. 108). What separated them a century ago was both.

Group survival rates were always correlated with average incomes in the past. We have not yet found any century in which the poor out-lived the rich (apart from episodes

[20] The upward shift over time in the e_0 curve was emphasized by Samuel Preston (1980).

of civil violence and war), while there are plenty of historical examples where the rich out-lived the poor. Thus, in Roman Italy two millennia ago, adult mortality was worse for former slaves than for magistrates.[21] Several estimates from early modern Europe show that aristocrats outlived commoners, especially female aristocrats. The same correlation with socio-economic status persists today, both for infant and adult mortality, even in countries with comprehensive national health services. While survival rate gaps between different socio-economic groups may have been eternal, we lack enough evidence to say exactly when they widened or narrowed.

Survival inequalities across individuals deserve at least as much attention as survival inequalities across classes or nations. History offers two clear insights on the issue. First, inequality among individual lifetime incomes has always been greater than inequality among individual annual incomes. Second, the historical trend in the inequality of lifetime incomes must have been sharply downward to the extent that those five hundred years of improvement in life spans illustrated in Figure 8 were driven in large part by improvements in infant and child survival. For example, infant mortality in Africa south of the Sahara today is only 10 percent, while it was over 12 percent in the United States in 1900 and 17 percent in England in the late eighteenth century.

People today in modern pre-industrial societies are endowed with much more equal life span (and morbidity) chances than were their distant ancestors in ancient pre-industrial societies. It follows that lifetime-adjusted inequality is a lot less in today's pre-industrial societies.

[21] This point has been previously noted by Jackson (1994) and Hoffman *et al.* (2005).

The trend toward more equal survival rates has an interesting East Asian twist. Ancient China and Japan both had higher infant mortality than did the rest of the world, but children also had better survival chances *after* infancy, so that until the late eighteenth century overall life expectancy at birth was as good in East Asia as in Europe and even England. This demographic fact has had two important implications for the long-run evolution of East Asian inequality. First, those suggestions of ancient East Asian egalitarianism in Table 2 and Figure 2 were offset by highly unequal survival chances for East Asian newborns. Second, the twentieth century convergence in life expectancies was more dramatic for East Asia than it was for the rest of the Third World. For example, the share of Japanese infants dying in the first year of life dropped from 25 percent in 1776-1815, to 5 percent in the early 1950s, and to only 0.4 percent today. Ancient East Asia has moved from being relatively equal in income, but relatively unequal in life span, to being relatively equal in both today.

6. New Inequality Insights and an Agenda for the Future

We conclude by stressing three key aspects of inequality that ancient pre-industrial experience has uncovered. First, as measured by the Gini coefficient, income inequality in still-pre-industrial countries today is not very different from inequality in distant pre-industrial times. In addition, the variance between countries then and now is much greater than the variance in average inequality between then and now. Second, the *extraction ratio* – how much of potential inequality was converted into actual inequality – was significantly bigger then than now. We are persuaded that much more can be learned about inequality in the past *and* the present by looking at the *extraction ratio* rather than just at actual inequality. The ratio shows how powerful and extortionary are the elite, its institutions, and its policies. For example, in a regression using ancient inequality evidence (not included in the text) a dummy variable for colony has a strong positive impact on the *extraction ratio*. Furthermore, while a relation between conflict and actual inequality has proven hard to document on modern evidence (see Collier and Hoeffler, 2004), we conjecture that the introduction of the *inequality possibility frontier* and the *extraction ratio* might shed brighter light on that hypothesis. Third, differences in lifetime survival rates between rich and poor countries and between rich and poor individuals within countries were much higher two centuries ago than they are now, and this served to make for greater lifetime inequality in the past. Fourth, unlike the findings regarding the evolution of the 20th century inequality in advanced economies, our ancient inequality sample does not reveal any significant correlation between the income share of the top 1 percent and overall inequality. Thus, an equally high Gini could and was achieved in two ways: in some societies, a high income share of the elite coexisted with a yawning gap between it and the rest of society, and small differences in income amongst the non-elite; in other societies, the very top of income pyramid was followed by only slightly less rich people and then further down toward something that resembled a middle class. Why were some ancient societies more hierarchal while others were more socially diverse? While this paper has focused on inequality description in ancient societies, it has not explored the social structure underpinning inequality or its determinants.

We hope to fill these social structure blanks in a sequel to this paper. In addition, the sequel, with an augmented ancient inequality sample, will explore determinants of actual inequality and the *extraction ratio*. Three forces are likely to explain most of the variance in an augmented ancient inequality sample. First, initial resource endowments should matter, especially for ancient agricultural settlements. Different endowments imply different food crops, and different food crops imply different technologies. Some agrarian technologies imply constant returns (rice) and some increasing returns (wheat). The difference may matter for the inequality configuration of ancient inequalities. Second, whether the country is the colonizer or the colonized should matter. Throughout history, colonial powers have ruled by rewarding indigenous elites, not by mollifying the masses. Third, a mixture of political and market forces must have been at work, especially the former. More political power and patronage implies more inequality. The frequent claim that inequality promotes accumulation and growth does not get much support from history. On the contrary, great economic inequality has always been correlated with extreme concentration of political power, and that power has always been used to widen the income gaps through rent-seeking and rent-keeping, forces that demonstrably retard economic growth.[22]

[22] For a theoretical restatement and fresh international evidence on the growth costs of unequal political power, see Glaeser, Scheinkman, and Shleifer (2003).

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Appendix 1: Data Sources

Bihar (India) 1807

Expenditure class	Percentage of population	Average monthly expenditure per capita (in rupees)	Average monthly expenditure relative to mean
1	15.24	0.68	0.43
2	4.85	0.83	0.53
3	16.18	0.88	0.56
4	6.68	0.97	0.61
5	8.52	1.03	0.65
6	10.39	1.42	0.90
7	8.91	1.56	0.99
8	11.21	2.06	1.30
9	9.89	2.64	1.67
10	8.13	4.45	2.82
Total	*100*	*1.58*	*1*

Income distribution data: A household census survey was made by a British official (Hamilton) of Patna city and 16 rural districts in the region surrounding it, all of which we take to be representative of Bihar. He recorded family size and monthly family expenditures in rupees. The data are summarized by approximate deciles (Martin 1838).

Population and area: Population of 3,362,280 and area in km^2 from Martin (1838).

Urbanization rate: We use the rate for India (Jean-François Bergier and Jon Mathieu 2002: Table 1, 9-12% for 1800, based on Bairoch and Chandler).

Mean income in $PPP: 1820 GDP per capita in 1990 international dollars (Maddison 2001: 264).

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Brazil 1872

Occupational income (in milreis per annum)	Number of people in occupation	Average annual income relative to mean
72	223	0.23
100	1065836	0.32
108	1586	0.35
109	15	0.35
118	64263	0.38
120	62662	0.38
126	140	0.40
132	15	0.42
144	14261	0.46
155	45229	0.50
157	6736	0.50
161	239	0.52
163	426	0.52
175	677987	0.56
177	411664	0.57
178	86	0.57
179	874	0.57
180	292066	0.58
191	150	0.61
199	261	0.64
206	1466	0.66
207	16160	0.66
208	22	0.67
213	109	0.68
214	7	0.69
215	57619	0.69
218	60	0.70
229	142	0.73
232	272965	0.74
233	82	0.75
236	67294	0.76
237	182	0.76
240	6717	0.77
245	2872	0.79
247	962	0.79
250	18778	0.80
251	81	0.81
255	31	0.82
262	120545	0.84
266	623196	0.85
269	6088	0.86
270	64280	0.87
271	1925	0.87
272	2	0.87
282	24835	0.90

Occupational income (in milreis per annum)	Number of people in occupation	Average annual income relative to mean
283	777	0.91
286	1305	0.92
287	321	0.92
288	35	0.92
293	69	0.94
295	10478	0.95
297	31	0.95
300	460770	0.96
306	104	0.98
309	9423	0.99
310	54157	0.99
312	161	1.00
319	2156	1.02
323	1671	1.04
327	1254	1.05
340	31	1.09
343	848	1.10
348	399884	1.12
350	3236	1.12
354	179708	1.14
356	1499	1.14
359	86	1.15
360	41102	1.15
366	1	1.17
370	2410	1.19
377	1051	1.21
379	161	1.22
383	31	1.23
387	7699	1.24
391	1	1.25
394	8	1.26
397	620	1.27
406	4818	1.30
408	440	1.31
413	42	1.32
424	217	1.36
425	5494	1.36
431	7091	1.38
432	706	1.39
436	15	1.40
439	856	1.41
443	33797	1.42
445	11	1.43
450	10174	1.44
459	1181	1.47
460	69	1.48
464	81407	1.49
468	161	1.50
472	9195	1.51

Occupational income (in milreis per annum)	Number of people in occupation	Average annual income relative to mean
475	468	1.52
476	3	1.53
479	8	1.54
480	226013	1.54
490	3655	1.57
502	17	1.61
503	34	1.61
531	93744	1.70
533	2078	1.71
534	180	1.71
538	597	1.73
540	1782	1.73
544	80	1.74
545	161	1.75
546	723	1.75
549	65	1.76
550	941	1.76
552	6	1.77
554	181	1.78
565	597	1.81
572	75	1.83
574	34	1.84
576	104	1.85
580	19272	1.86
585	69	1.88
586	155	1.88
587	3	1.88
591	18874	1.90
593	7	1.90
594	659	1.91
595	4322	1.91
600	9123	1.92
612	3003	1.96
613	35	1.97
619	3849	1.99
620	498	1.99
623	303	2.00
628	103	2.01
637	155	2.04
641	16	2.06
646	239	2.07
648	3544	2.08
650	546	2.08
654	261	2.10
658	787	2.11
659	5	2.11
663	161	2.13
664	1214	2.13
668	75	2.14

Occupational income (in milreis per annum)	Number of people in occupation	Average annual income relative to mean
679	31	2.18
680	6	2.18
689	802	2.21
696	28907	2.23
701	69	2.25
708	37669	2.27
709	1878	2.27
712	3243	2.28
713	798	2.29
718	706	2.30
719	119	2.31
720	40182	2.31
722	1	2.32
732	46	2.35
750	113	2.41
753	550	2.42
763	75	2.45
764	62	2.45
768	36	2.46
771	981	2.47
774	1925	2.48
778	61	2.50
788	31	2.53
793	1641	2.54
797	1183	2.56
815	1287	2.61
816	2	2.62
817	1305	2.62
819	8138	2.63
820	4024	2.63
828	1501	2.66
829	1	2.66
831	26	2.67
832	2291	2.67
840	1419	2.69
849	248	2.72
850	354	2.73
859	75	2.76
861	239	2.76
864	1355	2.77
878	787	2.82
880	1555	2.82
885	41939	2.84
886	3698	2.84
890	4593	2.85
899	3272	2.88
900	70	2.89
919	394	2.95
928	9636	2.98

Occupational income (in milreis per annum)	Number of people in occupation	Average annual income relative to mean
929	962	2.98
934	991	3.00
941	884	3.02
945	151	3.03
950	432	3.05
954	528	3.06
955	2532	3.06
956	1006	3.07
958	4	3.07
984	335	3.16
985	8	3.16
992	556	3.18
1019	1809	3.27
1026	155	3.29
1034	1139	3.32
1050	787	3.37
1056	155	3.39
1062	14715	3.41
1063	156	3.41
1068	1261	3.43
1076	955	3.45
1077	17	3.45
1080	737	3.46
1082	731	3.47
1088	1	3.49
1089	30	3.49
1092	2713	3.50
1093	671	3.51
1097	394	3.52
1098	5	3.52
1151	502	3.69
1153	139	3.70
1160	4818	3.72
1166	139	3.74
1173	311	3.76
1181	8972	3.79
1182	12	3.79
1187	65	3.81
1190	11526	3.82
1200	103	3.85
1210	692	3.88
1223	643	3.92
1242	214	3.98
1245	90	3.99
1246	155	4.00
1273	31	4.08
1296	1969	4.16
1299	36	4.17
1320	437	4.23

Occupational income (in milreis per annum)	Number of people in occupation	Average annual income relative to mean
1327	543	4.26
1328	2166	4.26
1349	741	4.33
1358	31	4.36
1365	362	4.38
1386	181	4.45
1392	2409	4.46
1417	1731	4.55
1424	1171	4.57
1425	26	4.57
1431	377	4.59
1436	388	4.61
1441	104	4.62
1464	22	4.70
1466	155	4.70
1477	569	4.74
1487	3872	4.77
1512	813	4.85
1526	75	4.89
1558	322	5.00
1560	254	5.00
1576	4	5.06
1587	13	5.09
1594	1204	5.11
1600	1984	5.13
1614	119	5.18
1631	214	5.23
1634	522	5.24
1638	3436	5.25
1639	335	5.26
1661	13	5.33
1662	26	5.33
1717	151	5.51
1728	1575	5.54
1729	69	5.55
1759	155	5.64
1771	17197	5.68
1772	949	5.68
1780	450	5.71
1784	630	5.72
1795	17	5.76
1799	716	5.77
1800	451	5.77
1830	5	5.87
1868	450	5.99
1890	42	6.06
1899	26	6.09
1908	604	6.12
1948	502	6.25

Occupational income (in milreis per annum)	Number of people in occupation	Average annual income relative to mean
1953	13	6.26
1970	4	6.32
1984	246	6.36
2000	14255	6.42
2039	164	6.54
2052	155	6.58
2077	78	6.66
2125	300	6.82
2136	180	6.85
2153	716	6.91
2154	51	6.91
2160	1181	6.93
2184	904	7.01
2186	1341	7.01
2279	123	7.31
2290	226	7.35
2362	73	7.58
2363	285	7.58
2374	103	7.61
2379	90	7.63
2400	1190	7.70
2457	181	7.88
2491	90	7.99
2492	180	7.99
2500	132	8.02
2592	787	8.31
2600	66	8.34
2656	1852	8.52
2691	119	8.63
2732	335	8.76
2833	100	9.09
2848	180	9.14
2862	75	9.18
2882	35	9.24
2928	90	9.39
2953	285	9.47
2974	1711	9.54
2975	26	9.54
3000	5620	9.62
3053	75	9.79
3113	540	9.99
3200	66	10.26
3229	358	10.36
3275	362	10.50
3519	155	11.29
3541	1371	11.36
3543	36	11.36
3560	720	11.42
3561	13	11.42

Occupational income (in milreis per annum)	Number of people in occupation	Average annual income relative to mean
3600	66	11.55
3906	13	12.53
3967	78	12.72
4000	7703	12.83
4320	394	13.86
4461	180	14.31
4675	161	15.00
4748	78	15.23
4799	448	15.39
4800	464	15.40
5000	1520	16.04
5312	694	17.04
5339	90	17.13
5459	181	17.51
5856	90	18.78
5859	13	18.79
5936	13	19.04
5948	540	19.08
6000	3774	19.25
7119	540	22.83
7123	39	22.85
8000	934	25.66
8784	90	28.18
8899	90	28.54
9598	138	30.79
10000	244	32.08
10679	270	34.25
12000	403	38.49
14000	75	44.91
14396	64	46.18
19195	34	61.57
20000	132	64.15
23994	22	76.96
28793	3	92.36
30000	66	96.23
33592	35	107.75
Total	*312*	*1*

Income distribution data. The occupational data come from the Brazilian 1872 Census. The annual incomes by occupation were estimated by the team of economic historians Bértola, Castelnovo, Reis and Willebald (2006). The original data include 813 professional groups. For simplicity they are consolidated in the table shown above: different professions with the same estimated income are summed up.

Population and area. Current land area of Brazil. Population from Maddison (2004).

Urbanization rate. The 1872 urbanization rate (share of cities 50,000 or greater) is 5.1 precent, interpolated from Banks (1976).

Mean income in $PPP. From Maddison (2004).

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Byzantium 1000

Social group	Percentage of population	Per capita income (in nomisma per annum)	Income in terms of per capita mean
Tenants	37	3.5	0.56
Farmers	52	3.8	0.61
Large landowners	1	25	4.02
Rural	90	3.91	0.63
Urban 'marginals'	2	3.5	0.56
Workers	3	6	0.97
Traders, skilled craftsmen	3.5	18	2.90
Army	1	6.5	1.05
Urban excluding nobility	9.5	9.9	1.60
Nobility	0.5	350	56.31
Total	*100*	*6.22*	*1*

Notes: Nobility includes civil and military nobility. The average household size estimated at 4.3 (see Lefort, 2002).

Income distribution data. Taken directly from Milanovic (2006: Table 5, p. 465). Rural incomes are based mostly on Lefort (2002) who quantifies population shares and incomes of several classes; rural population is divided into tenants (*pariokoi*); farmers that include both landowning peasants and (not very numerous) hired farm workers and slaves working on large estates; and large landowners. Urban population is, following Morrisson and Cheney (2002), divided into four classes plus nobility (both civilian and military). Additional explanations given in Milanovic (2006: pp. 461-8).

Other incomes and wages (for comparison and illustrative purposes):

	Amount in nomisma	Amounts in terms of the estimated average annual income	Source
Heads of *themes* (administative units) annual wage (around year 900)	360 to 720	58 to 115	Ostrogorsky (1969, p. 246)
Heads of the three most important *themes* (around year 900)	2880	~460	Ostrogorsky (1969, p. 246)
Military commanders	144	23	Morrisson and Cheynet (2002, p. 861)

Population and area. For population, see Milanovic (2006, p. 461). It is a compromise estimate (15 million) based on Treadgold (2001), Andreades (1924) and Harl (1996). Area: Treadgold (2001, p. 5).

Urbanization rate. See Milanovic (2006, p. 461), based on Bairoch's (1985) cut-off point of 5,000 inhabitants.

Mean income in $PPP. Average income (6.22 *nomisma*) divided by the estimated subsustence minimum (3.5 *nomisma*), and the latter priced at $PPP 400 at 1990 international prices. This gives (6.22/3.5*400) mean income of $710 in $PPPs. From Milanovic (2006, pp. 456-7).

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China 1880

Social group	Population (in 000)	Percentage of population	Total income (in taels)	Income as a share of total income (%)	Income per capita (in *taels* per annum)	Income in terms of per capita mean
Commoners	370000	98.0	1821047	74.4	4.92	0.76
Upper gentry	1050	0.3	380120	15.5	362.0	55.7
Lower gentry	6450	1.7	247605	10.1	38.4	5.91
Gentry	7500	2.0	627725	25.6	83.7	12.9
Total	*377500*	*100*	*2448772*	*100*	*6.5*	*1*

Income distribution data. The calculations are based on Supplement 2 ("The gentry's share in the national product") from *The Income of the Chinese Gentry*, by Chung-li Chang, University of Washington Press, Seattle 1962, pp. 326-333.

Gentry per capita incomes. The supplement provides a careful breakdown of gentry incomes by different sources, division of these income sources between upper and lower gentry, and the population shares of both types of gentry (see the table below which is derived from Chang's Supplement 2). The rest of the book gives the data on Chinese GDP and taxes from which one can calculate total household disposable income, and when combining this information with the estimates of gentry total income and its share in the Chinese population, calculate gentry's (upper's and lower's) per capita incomes (see the last line in the table below).

Main sources of gentry income, according to Chang, are:

(i) Government office-holding (administration) which was confined to gentry only. Income from government jobs provided resources for purchase of land and thus income from landownership. Land was a much less important source of income than at a similar stage in European history.

(ii) Gentry service in local affairs (managerial income); basically local administration.

(iii) Assistants to officials (secretarial services).

(iv) Teaching. Unlike the first three, they are private services. Only higher education (teaching) was monopolized by the gentry.

(v) Other services include medicine, writing etc. They are of much smaller importance.

In professions (i) to (iii) actual incomes (as calculated by Chang) were several times larger than the official wages. It was a policy to keep official wages low and give large premiums (the *yang-lien* allowance, see Chang p.13).

Commoners' per capita incomes. Once gentry per capita incomes are derived, commoners' incomes are obtained as the residual (using total household disposable income, line *d* in Table below, minus gentry's total income, and dividing by commoners' total population). The estimated commoners' per capita income of 4.92 taels should be contrasted with the estimated subsistence minimum (based on wage data) which was between 5 and 6 taels (Chang). If we consider Maddison's (2004) estimated China GDI per capita of $PPP 540 and Chang's average income of 6.5 taels to be the same (as they should be), then the subsistence minimum of $400 works out to be 4.8 taels. This indirectly obtained subsistence minimum is quite close to the directly calculated one (from Chang) of 5 to 6 taels per annum. This further corroborates both the subsistence minimum and the average figures.

Derivation of incomes of the upper and lower gentry

		Income shares:		Estimated total income	
Source of gentry income	Estimated amonts (in 000 *taels*)	Upper gentry	Lower gentry	Upper gentry	Lower gentry
	(1)	(2)	(3)	(1)x(2)	(1)x(3)
Office-holding	121000	1	0	121000	0
Gentry service	111000	0.18	0.82	20250	90750
Secretarial services	9050	0	1	0	9050
Teaching	61575	0	1	0	61575
Other services 1/	9000	0.2	0.8	1800	7200
Landholding	220000	0.7	0.3	154000	66000
Mercantile activity	113600	0.7	0.3	79520	34080
Total gentry income	645225			376570	268655
plus Imputed rent	30000	0.34	0.66	10200	19800
m*inus* direct taxes	47500	0.14	0.86	6650	40850
(a) Disposable gentry income	627725			380120	247605
(b) China-wide GNP	2781272				
(c) Total taxes	332500				
(d) Household disposable income: (b)-(c)	2448772				
(e) Gentry population (in 000 people)	7500	0.14	0.86	1050	6450
Disposable income (in tael per capita p.a.) = (a)/(e)				*362*	*38*

Sources: Gentry incomes, Table 26, page 197. Imputed rent and GDP, p. 326. Number of gentry: p. 327 (average hopusehold size = 5). Direct taxes: p. 329. Upper and lower gentry shares in total gentry income: p. 330. All references to Chung-li Chang (1962). 1/ Upper and lower gentry's shares for other services assumed.

Other incomes and wages (for comparison and illustrative purposes):

Position	(1) Official wage (taels p.a.)	*(2)* *Yang lien*(taels p.a.)	(1)+(2) in terms of the estimated overall income mean	Source
District magistrate	45	1000	~160	Chang, p.13
Governor	150	12000	~1900	Chang, p.13
Highest level military rank*	605		93	Chang, p.13
Seventh level military rank*	36		5.5	Chang, p.13
Highest level court official*	307		47	Chang, p.35
Ninth level court official*	54.4		8.3	Chang, p.35

*/ Wages include income in kind. Note: *Yang lien* is an allowance paid on top of the official wage.

Population and area: Population from Maddison (2004). Area: Current area of the People's Republic of China plus Taiwan.

Urbanization rate: From Bairoch, *De Jéricho à Mexico*, NRF, Gallimard, 1985, p. 462. Based on population living in towns that are greater than 5,000 inhabitants.

Mean income in $PPP. From Maddison (2004).

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England and Wales, 1688

Social group	Number of people	Percentage of people	Income per capita (in £)	Income in terms of per capita mean
Temporal lords	8000	0.14	151.5	15.83
Baronets	12800	0.22	93.8	9.80
Merchants on land, greater	19584	0.34	66.7	6.97
Spiritual lords	520	0.01	65.0	6.79
Knights	7800	0.14	61.5	6.43
Esquires	30000	0.53	56.3	5.88
Merchants by sea, greater	16000	0.28	50.0	5.23
Artisans and handicrafts	26980	0.47	50.0	5.23
Gentlemen	120000	2.11	35.0	3.66
Merchants by sea, lesser	48000	0.84	33.3	3.48
Merchants on land, lesser	78342	1.38	33.3	3.48
Persons in offices, greater	40000	0.70	30.0	3.14
Law	56434	0.99	22.0	2.30
Persons in offices, lesser	30000	0.53	20.0	2.09
Naval officers	20000	0.35	20.0	2.09
Military officers	16000	0.28	15.0	1.57
Clergymen, greater	10000	0.18	14.4	1.50
Freeholders, greater	192976	3.39	13.0	1.36
Science and Liberal Arts	64490	1.13	12.0	1.25
Freeholders, lesser	482450	8.48	11.0	1.15
Clergymen, lesser	50000	0.88	10.0	1.05
Shopkeepers and tradesmen	457668	8.04	10.0	1.05
Farmers	516910	9.09	8.5	0.89
Manufacturing trades	732883.5	12.88	8.4	0.88
Common soldiers	70000	1.23	7.0	0.73
Common seamen	150000	2.64	6.7	0.70
Building trades	328581	5.78	5.6	0.58
Laboring people & outservants	997489.5	17.53	4.3	0.45
Miners	64080	1.13	3.3	0.35
Cottagers and paupers	1017845	17.89	2.0	0.21
Vagrants	23489	0.41	2.0	0.21
Total	*5689322*	*100*	*9.57*	*1*

Income distribution data. The source is the Lindert-Williamson revision of Gregory King's social table (available at http://www.econ.ucdavis.edu/faculty/fzlinder/King1688revised.htm). The data which were originally presented on per household basis are transformed on per capita basis (each individual is assigned per capita income of his/her household).

Population and area. Current territory of England and Wales. Population: obtained directly from King's numbers.

Urbanization rate. Bairoch (1985: Table 13/1, p. 279) gives the year 1700 range (based on cities greater than 5,000) to be 13 to 16 percent. For 1688, we have used the lower bound of the range (13 percent).

Mean income in $PPP. Obtained by interpolation from Maddison's (2001, p. 247) estimates of English and Welsh GDI per capita in 1600 and 1700. An alternative calculation based directly on King's estimates yield almost the same result. If we take the ratio between the mean income from King's social table (9.6 pounds per capita per annum) and the subsistence minimum assumed to be one-third above the vagrants' income (2.7 pounds), we get a mean income which is 3.5 times the subsistence which, combined with the subsistence minimum of $PPP 400, yields an average income of $PPP 1400. The interpolation based on Maddison's data is $PPP 1418.

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England and Wales, 1801-3

Social group	Number of people	Percentage of people	Per capita income (in £)	Income in terms of per capita mean
Temporal peers	7175	0.08	320.0	14.59
Spiritual peers	390	0.004	266.7	12.16
Eminent merchants, bankers	20000	0.22	260.0	11.86
Baronets	8100	0.09	200.0	9.12
Knights	3500	0.04	150.0	6.84
Esquires	60000	0.66	150.0	6.84
Educators in universities	2000	0.02	150.0	6.84
Warehousemen, wholesale	3000	0.03	133.3	6.08
Manufacturers	150000	1.66	133.3	6.08
Building & repairing ships	1800	0.02	116.7	5.32
Higher civil offices	14000	0.15	114.3	5.21
Lesser merchants, by sea	91000	1.01	114.3	5.21
Shipowners, freight	25000	0.28	100.0	4.56
Gents	160000	1.77	87.5	3.99
Eminent clergymen	6000	0.07	83.3	3.80
Law, judges to clerks	55000	0.61	70.0	3.19
Liberal arts and sciences	81500	0.90	52.0	2.37
Keeping houses for lunatics	400	0.004	50.0	2.28
Theatrical pursuits	4000	0.04	50.0	2.28
Lesser offices	52500	0.58	40.0	1.82
Engineers, surveyors, etc.	25000	0.28	40.0	1.82
Merchant service	49393	0.55	40.0	1.82
Marines and seamen	52906	0.58	38.0	1.73
Freeholders, greater	220000	2.43	36.4	1.66
Shopkeepers and tradesmen	372500	4.11	30.0	1.37
Tailors, milliners, etc.	125000	1.38	30.0	1.37
Confined lunatics	2500	0.03	30.0	1.37
Naval officers	35000	0.39	29.8	1.36
Common soldiers	121985	1.35	29.0	1.32
Military officers	65320	0.72	27.8	1.27
Education of Youth	120000	1.33	25.0	1.14
Lesser clergymen	50000	0.55	24.0	1.09
Dissenting clergy, itinerants	12500	0.14	24.0	1.09
Farmers	960000	10.60	20.0	0.91
Innkeepers and publicans	250000	2.76	20.0	0.91
Freeholders, lesser	600000	6.63	18.0	0.82
Clerks and shopmen	300000	3.31	15.0	0.68
Artisans, mechanics, laborers	2005767	22.16	12.2	0.56
Vagrants	175218	1.94	10.0	0.46
Laborers in mines, canals	180000	1.99	8.9	0.41
Hawkers, pedlars, duffers	4000	0.04	8.0	0.36
Laborers in husbandry	1530000	16.90	6.9	0.31
Persons imprisoned for debt	10000	0.11	6.0	0.27
Paupers	1040716	11.50	2.5	0.11
Total	*9053170*	*100*	*21.93*	*1*

Income distribution data. Based on Colquhoun 1801-3 social table revised by Lindert and Williamson. Available at http://www.econ.ucdavis.edu/faculty/fzlinder/Colquhoun180103.htm. The data which were originally presented on per household basis are transformed on per capita basis (each individual is assigned per capita income of his/her household).

Population and area. Current territory of England and Wales. Population: As obtained directly from Colquhoun (coincides within 1 percent with the population for year 1800 from Maddison, 2001).

Urbanization rate. Estimated from Allen (2003, Figure 9, p. 428).

Mean income in $PPP. Maddison (2001) for year 1800.

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Holland 1561 and 1732

Income distribution data: The rental values of all dwellings (including the poor) were taxed. We know that dwelling rents were highly correlated with income (Williamson 1985; van den Berg and van Zanden, 1988: pp. 193-215), but we also know that the elasticity of rents to income was less than one (between 0.72 and 0.75 in 1852-1910 Britain: Williamson 1985, p. 225). Thus, income inequality should be understated by rental values. With that understood, the source of the Dutch data is van Zanden (1995). We have not yet been able to secure the underlying distribution data from the author.

Population and area: Population is interpolated between 1500 and 1600 (983,176), and between 1700 and 1820 (2,002.783), from Maddison (2001). We approximate the area of 21,680 km^2 to be modern Holland.

Urbanization rate: For 1561, the urbanization estimate (45%) is from van Bavel and van Zanden (2004). For 1732, the urbanization estimate (39%) is from de Vries (1985).

Mean income in $PPP: GDP per capita in 1990 international dollars interpolated between 1500 and 1600, and between 1700 and 1820, from Maddison (2001: p. 264).

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India (Moghul) around 1750, and India (British) 1947

India–at the end of the Moghul rule (around 1750)

Social group	Percentage of population	Percentage of total income	Income in terms of per capita mean
Nobility, zamindars	1	15	15.0
Merchants to sweepers	17	37	2.2
Village economy	72	45	0.6
Tribal economy	10	3	0.3
Total	*100*	*100*	*1*

India–at the end of the British rule (1947)

Social group	Percentage of population	Percentage of total income	Income in terms of per capita mean
British officials, traders	0.06	5	83.3
Nobility, Indian capitalists	0.94	9	9.6
Petty traders, govt & industrial workers	17	30	1.8
Village rentiers	9	20	2.2
Working land proprietors	20	18	0.9
Sharecroppers, tenants	29	12	0.4
Landless peasants	17	4	0.2
Tribal economy	7	2	0.3
Total	*100*	*100*	*1*

Note: Zemandars are large landowners. The data refer to the entire Indian subcontinent (today's India, Pakistan and Bangladesh).

Income distribution data. The source of both data is Maddison (2002) which is turn based on Maddison (1971: pp. 33 and 69). Maddison (2002) gives only population and income shares, but if we combine this information with Maddison's own estimates of GDI per capita for India (see below), we can calculate $PPP income estimates for each social group. Indian Moghul data present a particular problem because there are only 4 social classes given. Since their incomes are vastly different, and the largest group (72 percent; village economy) is in the middle of income distribution, probably spanning people with very different incomes, Gini2 is unusually some 27 percent higher than the minimum Gini (G2 is 48.9 vs. Gini minimum 38.5).[23]

Discussion: Note that a part (but only a part) of high Indian inequality around the time of the independence from Great Britain is caused by very high incomes of the British in India. According to Maddison, 0.06 percent of the population (British officials and businessmen) received 5 percent of total income which made their average per capita income more than $PPP 51,000 per year (and would place them in the top 5 percent of

[23] For the definitions of G1 and G2, see the main text.

today's US income distribution). Yet, despite these incomes being extravagantly high, this is only a part of the story since Gini without the British is still at a rather high level of 45 (as opposed to 48-49 with them). Consequently, the main cause of the very high inequality is a very low income level of the poor classes (a point discussed in the main text with regard to the appropriateness or not of using the subsistence minimum of $PPP 400).

One can also compare the without-the-British inequality in India in 1947 to the inequality results derived from the first Indian National Sample Survey (NSS) conducted in 1951. The expenditure-based NSS Gini is only 36.[24] So—(1) are expenditures significantly more equally distributed, compared to income, than we would expect (a conventional adjustment, suggested by Li, Squire and Zou (1998), is 5 to 6 Gini points while here the difference is 9 Gini points),[25] or (2) is Maddison overestimating India's 1947 inequality; or (3) is he underestimating income of India's poor, or (4) did inequality go down by several Gini points between the end of the British *raj* and 1951?

Population and area. The Indian population in 1750 is estimated from Maddison (2003: appendix HS-8, Table 8a, p. 256). Interpolation based on the data for 1700 and 1820. The population for 1947 is taken directly from Maddison (2003). For both dates, the area includes the entire Indian subcontinent (today's India, Pakistan and Bangladesh).

Urbanization rate. For 1750, from Bergier and Matthieu (2002: Table 1, original sources given there). Obtained by interpolation from the urbanization rates of the Indian subcontinent of 11-13 % in 1700 and 9-12% in 1800. The paper available at http://eh.net/XIIICongress/cd/papers/33BergierMathieu422.pdf#search=%22urbanization%20rate%20british%20india%22. For 1947, obtained as interpolation between the urbanization rate of 14.1% in 1941 and 17.6% in 1951; see Mohan (1985: Table 1, p. 621).

Mean income in $PPP. From Maddison (2004), "World population, GDP and per capita GDP, 1-2000 AD", available at http://www.ggdc.net/Maddison/content.shtml. For around 1750, we assume the same income as in 1820 (the first year in Maddison's series). For 1947, the value is taken directly from Maddison (2004).

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[24] See WIDER data set available at http://www.wider.unu.edu/wiid/wiid.htm, available also at http://econ.worldbank.org/projects/inequality (all the Ginis dataset).

[25] And it could easily be argued that the difference ought to be less since data from social tables are very rough in that they assign the same income for an entire class of people and do not allow for the fact that some people from a mean-poorer class may have higher incomes than some people from a mean-richer class.

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Kingdom of Naples 1811

Income Class	Percentage of population	Income per family (in ducats)	Income per capita (in ducats pa)	Income in terms of per capita mean
1	10	200	38	0.58
2	10	230	44	0.67
3	10	260	50	0.75
4	10	260	50	0.75
5	10	260	50	0.75
6	10	260	50	0.75
7	10	260	50	0.75
8	10	260	50	0.75
9	10	260	50	0.75
10	6	600	114	1.74
11	3.3	1500	286	4.34
12	0.7	5000	952	14.47
Total	*100*		*65.8*	*1*

Note: Average household size (5.25) assumed to be the same across all income groups

Income distribution data. The source is Malanima (2006: p. 31), who uses the tax census data from 1811. This tax census is, for the purposes of establishing an estimate of income distribution, better than others because it surveyed not only tax paying units but also the poor (the indigent). Each of the 14 provinces of the Kingdom was supposed to place people in predetermined nine categories, running from the poorest to the richest (by family income). The percentage of people placed in each category was "free" (that is, left to each village, city etc.) with the only stipulation that not more than one-sixth of the population may be placed in the bottom category (the "indigent") and hence be exempt from taxation. The problem is that it imposes an equality of conditions across provinces and leads to an underestimation of incomes in the rich areas like Naples-city. For example, people with a same income may be placed in category III in Naples and in higher category IV in a poorer province. Similarly, the number of poor in Naples (which was probably high) might have been underestimated (because of the imposed threshold of one-sixth). Yet, with the exception of the Naples-city (then the third largest European city containing about 6 percent of the total Kingdom's population), which also displayed relatively high inequality,[26] income differences between the provinces were too small to lead to significant and systematic misplacing of households. The ratio of mean rural incomes between the richest and poorest province was less than 1.5 to 1 (and rural population accounted for 85% of the total population).[27]

Another problem is that the authorities in each province might have been tempted to underestimate people's incomes and to push more people into lower classes so that taxes

[26] The Gini given by Malanima (2006) is 53.
[27] Excluding Naples-city, the same ratio for the urban areas is even narrower: 1.4 to 1 (calculated from Malanima).

would be minimized. This is reflected in the fact that some 75 percent of families were grouped in the second class (just above the indigent; see Malanima 2006, Table 3, p. 9).[28] Malanima, however, revises these original data, uses information about salaries and other sources of income, and constructs a new distribution (which we use here) composed of nine groups, each consisting of 10 percent of the population, and the top decile divided into three groups (see Malanima 2006: Appendix). We thus obtain an income distribution composed of twelve groups ranked by their estimated per capita income.

Population and area. Malanima (2006: p.3).

Urbanization rate. Malanima (2006: Table 7, p. 15)

Mean income in $PPP. Obtained as the ratio between the mean income of the Kingdom of Naples as calculated from Malanima data (65.8 ducats per capita per annum) and the subsistence minimum (31 ducats per capita for a five-member family in rural areas, and up to 50 ducats per capita in urban areas). Taking relative shares of urban and rural populations (85 and 15 percent), we estimate the subsistence minimum at 35 ducats per person annually. Mean income is thus 1.9 times the subsistence. Taking $PPP 400 for the subsistence, results in mean income of $PPP 752. This can be contrasted with Maddison's (2004) estimate of Italy's 1820 GDI per capita of $PPP 1117. Since Kingdom of Naples was poorer than most of Italy (north of Naples), the difference seems plausible.

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[28] It is notable however that the quota for the indigent which was 16.6 percent was not fulfilled: in total, only 14.4 percent of families were placed in this group and thus tax-exempt.

Nueva España 1790

	Percentage of population	Annual income per family (pesos)	Annual income per capita (pesos)	Average income per capita relative to mean
Spanish upper class	10	1,543	309	6.12
Mestizo middle class	18	300	60	1.19
Indigenous peasant class	72	61	12.2	0.24
Total	*100*	*252*	*50.4*	*1*

Note: Assumed household size = 5 for all social groups.

Income distribution data. In 1813, Manuel Abad y Queipo, Bishop of Michoacán, published his *Colección*. His social tables offer information on: family size; total population; three income classes with population shares and income per capita for the bottom two (the Spanish upper class 10% ; mestizo middle class 18% at 60 pesos; and indigenous peasant class 72% at 12.2 pesos). What is missing to complete the crude size distribution is either an estimate of average income per capita for the richest class or an estimate of total income for Nueva España as a whole. Our estimates use an average of the latter from three sources: Coatsworth's 240 million pesos in 1800 (Coatsworth 1978 and 1989); Rosenzweig's 190 million pesos in 1810 (Rosenzweig Hernández 1989); and TePaske's 251 million pesos in 1806 (TePaske 1985).

Population and area. Population estimate of 4,500,000 from *Colección* (1813). Modern Mexican borders are used to define the area of 1,224,433 km^2 since it appears that Manuel Abad y Queipo ignored New Mexico and California.

Urbanization rate. Calculated from cities with 10,000 or more inhabitants from von Humboldt (1822).

Mean income in $PPP: 1800 GDP per capita in 1990 international dollars (Coatsworth 2003 and 2005).

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Old Castille (Spain) 1752

Province	Families surveyed	Population	Annual income per family (in pesos)	Annual income per capita (in pesos)	Average annual income per capita relative to the mean
Villarramiel	94	376	250	62.5	0.26
Villarramiel	146	584	750	187.5	0.77
Villarramiel	58	232	1250	312.5	1.28
Villarramiel	38	152	1750	437.5	1.79
Villarramiel	19	76	2250	562.5	2.31
Villarramiel	8	32	2750	687.5	2.82
Villarramiel	6	24	3250	812.5	3.33
Villarramiel	1	4	3750	937.5	3.84
Villarramiel	8	32	5677	1419.25	5.82
Paredes	364	1456	250	62.5	0.26
Paredes	395	1580	750	187.5	0.77
Paredes	68	272	1250	312.5	1.28
Paredes	21	84	1750	437.5	1.79
Paredes	17	68	2250	562.5	2.31
Paredes	6	24	2750	687.5	2.82
Paredes	8	32	3250	812.5	3.33
Paredes	5	20	3750	937.5	3.84
Paredes	39	156	5677	1419.25	5.82
Palencia	943	3772	250	62.5	0.26
Palencia	483	1932	750	187.5	0.77
Palencia	219	876	1250	312.5	1.28
Palencia	101	404	1750	437.5	1.79
Palencia	56	224	2250	562.5	2.31
Palencia	28	112	2750	687.5	2.82
Palencia	36	144	3250	812.5	3.33
Palencia	19	76	3750	937.5	3.84
Palencia	89	356	5677	1419.25	5.82
Frechilla	56	224	68	16.9325	0.07
Frechilla	67	268	437	109.1875	0.45
Frechilla	89	356	594	148.615	0.61
Frechilla	34	136	866	216.4775	0.89
Frechilla	26	104	1223	305.8175	1.25
Frechilla	18	72	1810	452.4175	1.85
Frechilla	25	100	2460	614.97	2.52
Frechilla	8	32	3513	878.25	3.60
Frechilla	5	20	4351	1087.7	4.46
Frechilla	6	24	5546	1386.543	5.68
Frechilla	1	4	6918	1729.5	7.09
Frechilla	5	20	7325	1831.15	7.51
Frechilla	3	12	9975	2493.75	10.22
Villalpando	87	348	213	53.20402	0.22
Villalpando	106	424	341	85.1309	0.35
Villalpando	46	184	610	152.3859	0.62
Villalpando	21	84	832	208.0357	0.85
Villalpando	27	108	1247	311.7407	1.28
Villalpando	5	20	1683	420.8	1.73
Villalpando	17	68	2568	641.9559	2.63
Villalpando	8	32	3559	889.8438	3.65
Villalpando	2	8	4757	1189.125	4.87

Province	Families surveyed	Population	Annual income per family (in pesos)	Annual income per capita (in pesos)	Average annual income per capita relative to the mean
Villalpando	5	20	5509	1377.15	5.65
Villalpando	3	12	6569	1642.333	6.73
Total	*3945*	*15780*	*975.72*	*243.94*	*1*

Note: People (and families) ranked by per capita income within each province. Total gives the overall (Old Castille) mean. Old Castille is composed of five provinces: Villarramiel, Paredes, Palencia, Frechilla, Villalpando. Family size assumed to be 4 throughout.

Income distribution data. Family annual income estimates (in pesos) from five locations in the Palencia region, part of what is now Castilla y León: Frechilla (13 income classes) and Villalpando (11 income classes); Palencia city, Paredes de Nava, and Villarramiel (9 income classes each). These data were kindly provided by Leandro Prados, who used them recently in Álvarez-Nogal and Prados de la Escosura (2006), which in turn were taken from Yun Casalilla (1987: p. 465) and Ramos Palencia (2001: p. 70).

Population and area. Population of 1,980,000 and area of 89,061 km^2 are from Lees and Hohenberg 1989: pp. 443 and 445).

Urbanization rate. The 1750 estimate from Lees and Hohenberg (1989: p. 443).

Mean income in $PPP. GDP per capita for Spain, in 1990 international dollars interpolated between 1700 and 1820, from Maddison (2001: p. 264).

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Roman Empire 14

Social group	Number of members	People	Percentage of population	Average family income (in HS)	Average per capita income (in HS)	Income in terms of per capita mean
Senators 1/	600	2470	0.004	150000	37975	100
Knights (equestrian order) 1/	40000	158000	0.285	30000	7595	20
Municipal senators 1/	360000	1422000	2.562	8000	2025	5.3
Other rich people	200000	790000	1.423		4810	12.7
Legion commanders 8/	50	198	0.000	67670	17132	45.1
Centurions	2500	9875	0.018	16160	4091	10.8
Praetorians 3/	9000	35550	0.064	3000	759	2.0
Ordinary soldiers 2/	250000	987500	1.8	1010	256	0.7
Workers at average wage 7/	1066667	4213333	7.6	800	304	0.8
Tradesmen and service workers 5/	133333	526667	0.9		468	1.2
Farmers and farm workers (free or slave) 6/	12000000	47400000	85.4		234	0.6
Subsistence minimum 4/					180	0.5
Total		*55,500,000*	*100.0*		*380*	*1.0*

Note: The average household size of 3.95 (derived from Goldsmith, 1984) used throughout except for senators where the average household size (on account of many dependents) was increased to 4.1. HS = sestertius.

For explanation of the notes, see text below.

Income distribution data. The basis for calculations is provided by Goldsmith's (1984) estimates. Goldsmith provides minimum wealth (census qualification) for the three top classes (senators, knights and municipal senators) and an estimate of their mean incomes. The problem was that –taking these estimates as given, and assuming that the bulk of the working population lived at slightly above the subsistence minimum ($PPP 400)—one finds an overall lower mean income than given by Goldsmith and used here (HS 380). This is why we introduced, following Goldsmith who spoke of that class but did not put any numbers on it, a fourth rich class of "other rich people" who were neither Roman knights nor municipal senators (both of which needed to fulfill the census requirements). There is no doubt that that "fourth" rich class existed but putting a number on its size and average income is obviously difficult. We decided to take as their mean income the average of the two other higher classes' incomes (leaving out as decidedly the richest the class of Roman senators).

Notes to the table above

1/ From Goldsmith (1985). Total amount for senators includes HS15 million of Augustus' and Imperial households' (100 people) private fortune. The censuses, according to Goldsmith, were 1 milion for senators and 250,000 for the knights. According to Finlay (p. 46), the census for the knights was 400,000 HS. The average annual income of senators' class is calculated to be 15 percent of the census (note: census is the *threshold*) and for knights, 12 percent of the census amount.

2/ Calculated from Clark (p. 676): 225 denarii (1 denarius = 4 HS) *plus* 50 modii of wheat valued at 110 HS (Milanovic, 2006, Table 3). This makes the average wheat price 2.2 HS per modius. Harl (p. 276) gives modius price range from 8 asses (2 HS) in Egypt to 32 (8 HS) in Rome. Temin (2006, p. 138) gives free market price in Rome at 4-6 HS. After the huge Rome's fire in 64, Tacitus (Book XV, Chapter 39) mentions that the price of wheat in Rome, due to the sudden impoverishment of the population, dropped to 3HS per modius. We select a relatively low price to avoid inflating incomes by using Roman prices for the goods that were essentially consumed outside the capital.

Tacitus (Book I, Chapter 17) quotes soldiers (in year 14) complaining that a soldier is worth only 10 asses per day. That would be 2.5 HS per day or 912 HS per annum, some 10 percent below our estimate of HS 1010. Tacitus' number may refer to the monetary pay only, *i.e.*, it likely excludes payments in kind.

Size of the army (250,000) from Temin (2006, p. 147) quoting Goodman (1997). Similarly, Walbank (p.19) gives 250-300,000.

3/ Clark (p. 676). The size of the Praetorian guard was 9 cohorts each with 1,000 men.

4/ From Milanovic (2006, Table 4), based on Goldsmith (1984, p. 268) and the amount of *alimenta* paid from the public treasury to boys under 15 years of age.

5/ From Temin (2006, p. 136). We assume that their income was twice the subsistence. They are assumed to account for 10 percent of the urban population.

6/ Lowest class according to Temin (2006). We assume their average income to be 30% above the subsistence minimum. They account for more than 90 percent of the rural population (which in turn accounts for 90 percent of the total population).

7/ Based on Goldsmith (3.5 HS per day times 225 working days). Temin (2006, p. 138) gives also the average wage in Rome as 3-4 HS per day (see also Milanovic, 2006, Table 4 and the sources given there). Wages expressed at Rome-city prices (see discussion of mean income below). Workers are estimated to account for 80 percent of urban population.

8/ The legion's commander wage ratio (67 times ordinary soldier's wage) is given in Duncan-Jones (p. 116) who quotes Brunt (1950). The number of legion commanders calculated by dividing 250,000 soldiers by the average size of a legion (5,000 men; for the average size of the legion, see Duncan-Jones p. 215).

Discussion.
<u>(1) Slaves and landowners</u>. Slaves are not shown as a separate social category. This is because their economic conditions covered practically the entire spectrum of incomes (with a possible exception of the very top). Their consumption levels varied widely: they ranged from being very rich (owning slaves themselves) to being very poor (mostly slaves engaged in mining). Even rural slaves, who were on average worse-off than urban slaves, were not just "all undifferentiated gang laborers; [on the contrary] there are lists of rural slave jobs that are as varied as the known range of urban or household slave jobs" (Temin, no date, p. 8). For the urban slaves, who were more numerous than rural slaves, [29] the prevalence of manumission made Roman slavery (unlike that in the Americas) an "open slavery". Schiavone (2000) and Temin (no date) discuss the position of slaves and the role of manumission at great length. Similarly, landowners are not shown separately as a class since most landowners belonged to the four top classes and their incomes from land are included in our totals.

<u>(2) Top of the income distribution</u>. The estimated Gini of between 37 and 40 might seem low in the light of the excesses of wealth in Rome (see Table below with data gathered from Tacitus's *Annals*) But this extraordinary wealth was limited to a very few people at the very top. It is very unlikely that they would be even selected (so few they were) to participate in a modern random household survey. Moreover, their extraordinary wealth was not out of step with what we observe today. For example, the fabulously rich triumvir Marcus Crassus (-115 to -53) whose wealth was estimated at 200 million HS (Schiavone, 2000, p.71) and hence his income at HS 12 million per year,[30] has more than a counterpart in today's Bill Gates and other super rich. Crassus's income was equal to about 32,000 mean Roman incomes. Using today's US GDI per capita, the equivalent would be an income of about $1 billion per year. But this is an income that is easily made by many of today's hyper-billionaires and yet the overall inequality is not much affected by it. Bill Gates's fortune is estimated at $50 billion which with 5% interest yields $2.5

[29] According to Schiavone (2000, p.112), slaves represented 35 percent or more of Italy's population. And Italy was the most urbanized part of the Empire.
[30] Using the conventional interest rate of 6 percent (see Finley, 1985, p.104).

billion per year, i.e., more than twice as much as Crassus—expressed in mean incomes of one's own time and place. According to The *Forbes' Magazine* 2007 list of richest people in the world,[31] four individuals in the United States have wealth above $20 billion which would place them around Crassus's level.

Tacitus (Book XII, Chapter 53) gives the wealth of Pallas, a freedman, at 300 million HS. This would have been 50 percent more than Crassus's wealth. Augustius' household's private income was estimated (as mentioned above) by Goldsmith at HS 15 million. Using the conventional interest rate of 6 percent, it translates into a wealth of HS 250 million.

Other incomes and wages compiled from Tacitus' *Annals* (for comparison and illustrative purposes):

	Amounts in HS	Amounts in terms of the estimated average annual income (or GDP)	Source
Augustus' donative to each pretorian guardsman (year 14)	1000	2.6	Book I, Chapter 8
Augustus' donative to each legionnaire and soldier of cohorts (year 14)	300	0.8	Book I, Chapter 8
Augustus' donative to people (year 14)	43.5 million	0.2% of GDP	Book I, Chapter 8
Tiberius dowry to Agrippa's daughter (year 19)	1 million	~2600	Book II, Chapter 86
Left by the Senate to Senator Marcus Piso after his punishment (year 20)	5 million	~13,000 (or 5 times the senatorial census)	Book III, Chapter 17
Tiberius' personal loan to the banks (who were suffering from shortage of funds; year 33)	100 million	0.5% of GDP	Book VI, Chapter 25
Tiberius' donative after a large fire in Rome (year 36)	100 million	0.5% of GDP	Book VI, Chapter 51
Maximal lawyer's fee (year 47)	10,000	26	Book XI, Chapter 7
Consular reward for raising a pertinent issue in the senate (paid to a senator; year 52)	5 million		Book XII, Chapter 53
Nero's guaranteed annual income for Messala (year 58)	500,000	~1300	Book XIII, Chapter 34
Seneca's average annual earnings (years 55-58)	75,000	~200	Book XIII, Chapter 42
Nero's average annual gift to the	60 million	~0.3% of GDP	Book XV, Chapter

[31] Available at http://www.forbes.com/lists/2007/10/07billionaires_The-Worlds-Billionaires-North-America_6Rank.html.

state treasury (year 61)			18
Nero's subsidy to soldiers after they crushed Piso's conspiracy (year 65)	2,000	5.2	Book XV, Chapter 72
Nero's gift to Lyon (Lugdunum) after a big fire (year 65)	4 million	~0.02% of GDP	Book XVI, Chapter 13

Note: Augustus's donatives refer to the amounts given out at his death.
Inflation rate was estimated by Temin (2003, p. 149) to have been less than 1 percent p.a,, up to the end of the Julio-Claudian era in 69. Thus, later (post-Augustan) incomes ought to be deflated accordingly.

Population and area. Population is taken from Goldsmith (1984: p. 263). Goldsmith also gives the area as 3.3 million km^2, while Taagepera (1979: Table 2, p. 125) gives 3.4 million km^2 (for year 1, wrongly labeled as year 0).

Urbanization rate. Goldsmith's (1984: pp. 272-3) range is 9 to 13 percent with the former number "nearer the lower boundary at the beginning of the principate." (The urbanization rate seems to be calculated based on the cut-off point of 2-3,000 people). In addition to Rome, the population of which is conventionally estimated at 1 million (Bairoch 1985: p. 115), there were six cities (Carthage, Alexandria, Antioch, Ephesus, Pergamum and Apamea) with populations in excess of 100,000 (Schiavone 2000: p. 61). Taking their average size to be 150,000, it follows that about 2 million (or almost 4 percent of the population) lived in the cities that were larger than 100,000. For the urbanization rate, we use a median estimate of 10 percent.

Mean income in $PPP. Obtained by expressing mean income from Goldsmith (HS 380) in terms of the subsistence minimum (estimated at HS 180), and then pricing the latter at $PPP 400. This yields mean income of $PPP 844 in 1990 prices. In his most recent (2007) update (available at http://www.ggdc.net/maddison/) Maddison gives Italian National Disposable Income in year 14 as $PPP 806.

Discussion.
Temin (2003) argues that Goldsmith's calculation of the mean Roman income is too high. However, there are at least three counterarguments to Temin: (1) his critique of Goldsmith's calculations is not based on Goldsmith's methodology (which Temin praises) but on Goldsmith's apparent use of Rome-based wage rates for the rest of the Empire including Egypt where both wheat prices and wages were much lower in nominal terms. Temin then uses an average of the two nominal wage-rates, and obtains a significantly lower overall Imperial mean income. But that issue can be sidestepped by arguing that the Imperial numbers are expressed in Rome-city prices. This is acceptable since Temin (2003, p. 19) himself believes that *real* (wheat) wages in Egypt and Rome-city were about the same. Thus, Temin's metrhodology of averaging two nominal wage-rates seems faulty. (2) The level of infrastructural development, urbanization, size of a large standing army (almost ½ of a percent of total population), and the point made by Schiavone (2000) that regional differences in mean incomes might have been as high as 5 or even 6 to 1,[32] imply that an overall Imperial mean income was unlikely to have been

[32] If there are large inter-regional differences, and even the poorest region is at the subsistence, then the overall Imperial mean must be relatively high. Large regional differences are mentioned by Goldsmith too (1984: p. 265).

less than HS 380 (as calculated by Goldsmith) which, using the assumptions regarding the subsistence minimum, translates into about $PPP 850 (in 1990 prices). (3) There is the consistency argument against changing Goldsmith's mean income while retaining his other calculations.

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Appendix 2: The w/y Calculations

Observation	Gini mid-range Average Gini1 and Gini2	Average Economy Income (y)	Landless Peasant Income (Wr)	Urban Worker Income (Wu)	Wr/y	Wu/y
Rome 14: "workers @ ave. wage" = Wu "farmers & workers (free & slave)" = Wr	37.9	380	234	304	0.62	0.8
Byzantium 1000: "urban marginals" = Wu "tenants" = Wr	41.1	6.22	3.5	3.5	0.56	0.56
England 1688: "laboring people & servants" = Wu "cottagers & paupers" = Wr	45.0	9.6	2	4.3	0.21	0.45
England 1801-3: "laborers in mines & canals" = Wu, "laborers in husbandry" = Wr	51.5	21.93	6.9	8.9	0.31	0.41
Naples 1811: "income classes 3-9" = Wu "income class 2" = Wr	28.3	65.8	44	50	0.67	0.75
India 1750: "village economy" = Wr	43.7				0.6	
India 1947: "landless peasants" = Wr	48.9				0.2	
Brazil 1872: male day laborers in agriculture = Wr	38.7	312	212		0.67	
China 1880: "commoners" = Wr	24.2	6.5	4.92		0.76	
Old Castille 1752: "Palencia city, three lowest classes" = Wu, "four rural districts, two lowest **classes" = Wr**	52.4	975.72	491	530	0.5	0.54
Nueva Espana 1790: "indigenous peasant" = Wr	63.5	252	61		0.24	

Sources: Ginis are the average of Actual Gini1 and Actual Gini2 from Table 2. Average economy incomes are from Appendix 1. Wr and Wu are from Appendix 1, as defined.

Appendix 3: Derivation of top 1 percent income share

Define H(y)=cumulative percentage of people with incomes higher than y (the reverse of the normal distribution that cumulates people from the bottom income upwards).

Also H(y) follows a Pareto distribution:

$$(1)\ H(y) = Ay^{-a}$$

where a=Pareto exponent. If we do not have individual-level data but income distribution tables with grouped data (fractiles of income distribution), then y should ideally be the lower bound of the income interval. There are two differences between these requirements and the data we have. First, we have only social classes arranged by their mean incomes and population shares. In other words, we have percentages of people with an *average* income and do not know lower or upper bounds of their income ranges. Notice that the same problem exists when the data are arranged in deciles and only mean income by decile is available. Second, there are very likely "leakages"--namely people from lower (mean-poorer) social groups whose actual incomes are higher and should be part of the top (and the reverse). This problem is specific to the type of data we have here. These two departures of our data from the usual way income distribution statistics are displayed (even in grouped form) should be kept in mind.

Now, let us define G(y) = total income of those with incomes above y divided by total population; if it follows a Pareto distribution, then

$$(2)\ G(y) = \frac{a}{a-1} Ay^{-(a-1)}$$

Also, by definition, y_h = mean income of people with income greater than y, and

$$G(y) = \frac{y_h H(y) N}{N}$$

This means

$$(3)\ y_h = \frac{G(y)N}{H(y)N} = \frac{G(y)}{H(y)} = \frac{a}{a-1}\frac{A}{y^{a-1}}\frac{y^a}{A} = \frac{a}{a-1}y$$

For example, if the Pareto constant is 2, then mean income of those with income greater than y, will be $2y$.

Using (1) and (2), we can link G(y) and H(y):

$$(4)\ G(y)=\frac{a}{a-1}Ay^{-(a-1)}=\frac{a}{a-1}Ay^{-a}y=\frac{a}{a-1}H(y)y$$

Write the expression (4) to the exponent a:

$$(G(y))^{a}=\left(\frac{a}{a-1}\right)^{a}H^{a}y^{a}=\frac{a}{a-1}H^{a}\frac{A}{H}=KoH^{a-1}$$

where Ko = constant, and we use expression (1).

Now this means that

$$a\ln G=\ln K_0+(a-1)\ln H=K+(a-1)\ln H$$

where the constant K=ln Ko

Then,

$$\ln H=\frac{a}{a-1}\ln G+C$$

The ratio between the change in H and change in G is:

$$(5)\ \frac{\ln H1-\ln H2}{\ln G1-\ln G2}=\frac{(a/a-1)\ln G1-(a/a-1)\ln G2}{\ln G1-\ln G2}=\frac{a}{a-1}$$

Expression (5) is the key relationship that we fit in order to get the Pareto constant and to interpolate for the values that we do not have in the original data. For example, in the case of Rome we have H1=1.71 and H2=0.29. Now, the H1 people receive 24.4 percent of total income. And H2 people receive 6.2 percent of total income. The top 1 percent receive the share that is between the two.

Using (2) we find that the share of total income received by people whose income is greater than y, s(y), is equal to:

$$(6)\ s(y)=\frac{G(y)N}{\mu N}=\frac{G(y)}{\mu}$$

where μ=overall mean income.

We can then transform (5)

$$(7)\ \frac{\ln H1-\ln H2}{\ln G1-\ln G2}=\frac{\ln H1-\ln H2}{\ln s1+\ln\mu-\ln s2-\ln\mu}=\frac{\ln H1-\ln H2}{\ln s1-\ln s2}=\frac{a}{a-1}$$

(7) will be the key relationship when we do the estimation:

Thus,

$$\frac{\ln 1.71 - \ln 0.29}{\ln 24.4 - \ln 6.2} = \frac{0.536 - (-1.238)}{3.195 - 1.825} = \frac{1.774}{1.37} = 1.295$$

From which we find α=4.38.

Now, to find the income share of the top 1 percent, we use (7) again.

$$\frac{\ln 1.71 - \ln 1}{\ln 24.4 - \ln x} = 1.295$$

$$\frac{0.536}{3.195 - \ln x} = 1.295$$

And thus x=16.13.

We obtain the same result if we do:

$$\frac{\ln 1 - \ln 0.29}{\ln x - \ln 6.2} = 1.295.$$

Note that the data we have here are: (i) the bottom cut-off point (*y*), the share of people above that income level, H(y), and (iii) the share of total income they receive, s(y). The cut-off point is crucial. If we have only the means (for each fractile) and the percentage of people, we are effectively treating the fractile means as the bottom cut off points.

We can also get the important relationship between the income share and the number of people above the income level *y*. Using (4) and (6), we get

$$s(y)\mu = \frac{a}{a-1} H(y) y$$

and

$$s(y) = \frac{a}{a-1} H(y) \frac{y}{\mu}$$

If H(y)=1 percent, then s(y)=(a/a-1)(y/μ), where *y* is the cut-off point above which the top 1 percent of the population begins, and μ=overall mean. The ratio y/μ expresses, in terms of the overall mean, income level where the top 1 percent of population begins (the 1 percent cut-off point). Going back to the Roman example where we found $\alpha=4.38$ and $s(y)=16.13$, we can readily see that this implies a cut-off point of 12.4.

Table 1

Data Sources, Estimated Demographic Indicators and GDI Per Capita

Country/territory	Source of data	Year	Number of social classes	Estimated urbanization rate (in %)	Population (in 000)	Area (in km^2)	Population density (person/km^2)	Estimated GDI per capita
Roman Empire	Social tables	14	11	10	55000	3,300,000	13	844
Byzantium	Social tables	1000	8	10	15000	1,250,000	8	710
Holland	Tax census dwelling rents	1561	10	45	983	21,680	45.3	1129
England and Wales	Social tables	1688	31	13	5700	130,000	44	1418
Holland	Tax census dwelling rents	1732	10	39	2023	21,680	93.3	2035
Moghul India	Social tables	1750	4	11	182000	3,870,000		530
Old Castiille	Income census	1752	33	10	1980	89,061	22.2	745
Nueva España	Social tables	1790*	3	9.1	4500	1,224,433	3.7	755
England and Wales	Social tables	1801-3	44	30	9277	130.000	71.4	2006
Bihar (India)	Monthly census of expenditures	1807	10	10.5	3362	108,155	31.1	533
Kingdom of Naples	Tax census	1811	12	15	5000	82,000	61	752
Brazil	Professional census	1872	813	5.1	10167	8,456,510	1.2	721
China	Social tables	1880	3	7	377500	9,327,420	40.5	540
British India	Social tables	1947	8	16.5	346000	3,870,000	89	617

Notes: GDI per capita is expressed in 1990 Geary-Khamis PPP dollars (equivalent to those used by Maddison 2003 and 2004). Population density is people per square kilometer. For the data sources and detailed explanations, see Appendix 1.
* 1790 = 1784-1799.

Table 2

Inequality Measures

Country/territory, year	Gini1	Gini2	Top income class (in % of total population)	Mean income in terms of *s* (s=$PPP 400)	Maximum feasible Gini (IPF)	Actual Gini as % of the maximum (with s=400)*	Actual Gini as % of the maximum (with s=300)*
Roman Empire 14	36.4	39.4	0.004	2.1	52.8	75	61
Byzantium 1000	41.0	41.1	0.50	1.8	43.6	94	71
Holland 1561	56.0		1	2.8	64.5	87	76
England/Wales 1688	44.9	45.0	0.14	3.5	71.7	62	57
Holland 1732	63.0		1	5.1	80.3	78	74
Old Castille 1752	52.3	52.5	0.08	1.9	46.3	113	88
Moghul India 1750	38.5	48.9	1	1.3	24.5	200	113
Nueva España 1790	63.5		10	1.9	47.0	135	105
Bihar (India) 1807	31.1	32.8	10	1.3	35.5	135	77
England/Wales 1801-3	51.2	51.5	0.08	5.0	80.0	64	61
Naples 1811	28.1	28.4	0.7	1.9	46.8	61	47
Brazil 1872	38.7	43.3	1.0	1.8	44.5	97	74
China 1880	23.9	24.5	0.3	1.4	25.9	95	55
British India 1947	48.2	49.7	0.06	1.5	35.5	141	97
Modern comparators							
Brazil 2002		58.8		10.4	90.3	65	63
South Africa 2000		57.3		11.0	90.8	63	62
China 2001		41.6		8.6	88.3	47	46
United States 2000		39.9		57.8	98.2	41	40
Sweden 2000		27.3		39.2	97.3	28	28
Nigeria 2003		41.8		2.3	55.7	75	63
Congo, D.R., 2004		40.4		1.1	11.0	366	122
Tanzania 2000		34.4		1.4	26.0	133	77
Malaysia 2001		47.9		17.7	94.2	51	50

* Calculated using Gini2 measures unless it is unavailable, in which case Gini1 is used. Modern Ginis, calculated from individual-level data from national household surveys, are from World Income Distribution database, benchmark year 2002 (see http://econ.worldbank.org/projects/inequality).
Source: For ancient societies, see Appendix.

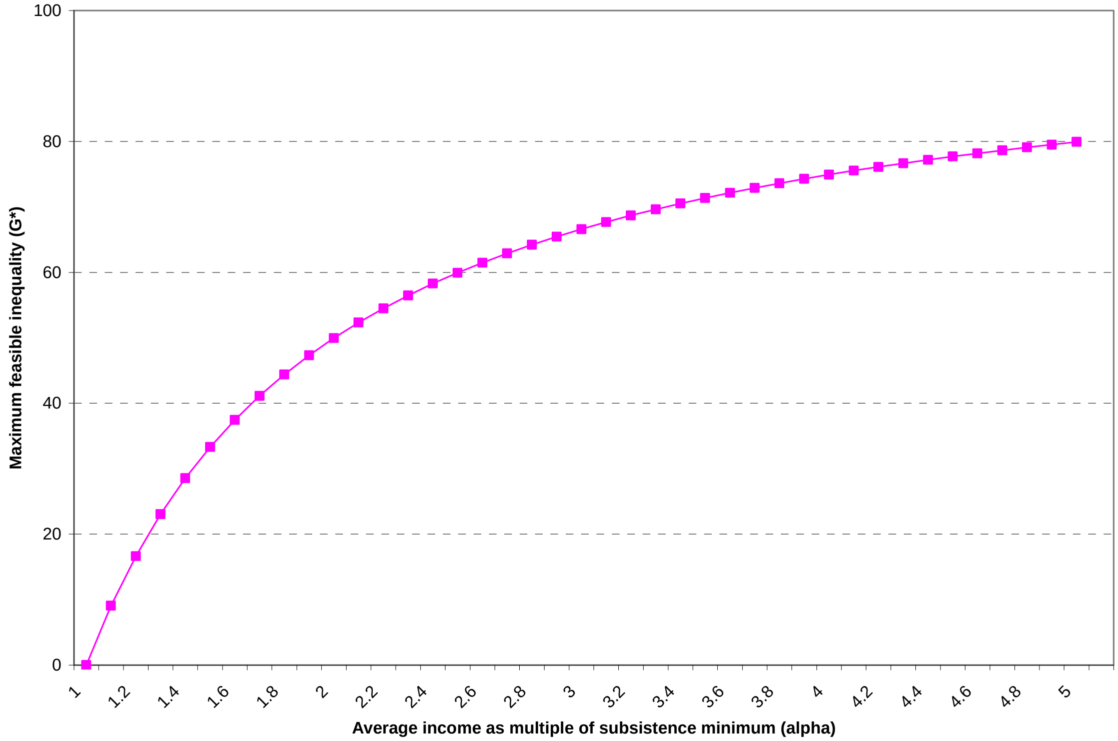
Table 3. Estimated top of income distribution

	Top 1% share in total income (in %)	The cut-off point (in terms of mean income)	Gini coefficient
Byzantium 1000	30.6	3.7	41.1
China 1880	21.3	5.6	24.5
Nueva España 1790	21.1	9.8	63.5
Rome 14	16.1	12.4	39.4
India-Moghul 1750	15.0	15.0	48.9
K. of Naples 18	14.3	5.5	28.4
India British 1947	14.0	16.9	49.7
Bihar 1807	11.5	3.8	33.5
Brazil 1872	11.2	5.7	38.7
England 1801	8.9	6.2	51.5
England 1688	8.7	6.1	45.0
Old Castille 1752	7.0	6.2	52.5
Mexico 2000	11.5	8.0	53.8
UK 1999	7.0	4.3	37.4
US 2000	6.6	4.7	40.2
Italy 2000	6.0	4.2	35.9
Germany 2000	4.9	3.6	30.3
France 2000	4.5	3.5	31.2

Note: Income distributions for Holland not available. All modern countries as calculated from LIS database (using disposable per capita income). The cut-off point indicates the income level (expressed in terms of overall country mean) where the top percentile begins. For the modern societies, it is estimated by taking the mean income of the 99th percentile and adding 3 standard deviations (of income within that percentile). Where available, the Gini is Gini2, otherwise Gini1 (Table 2).

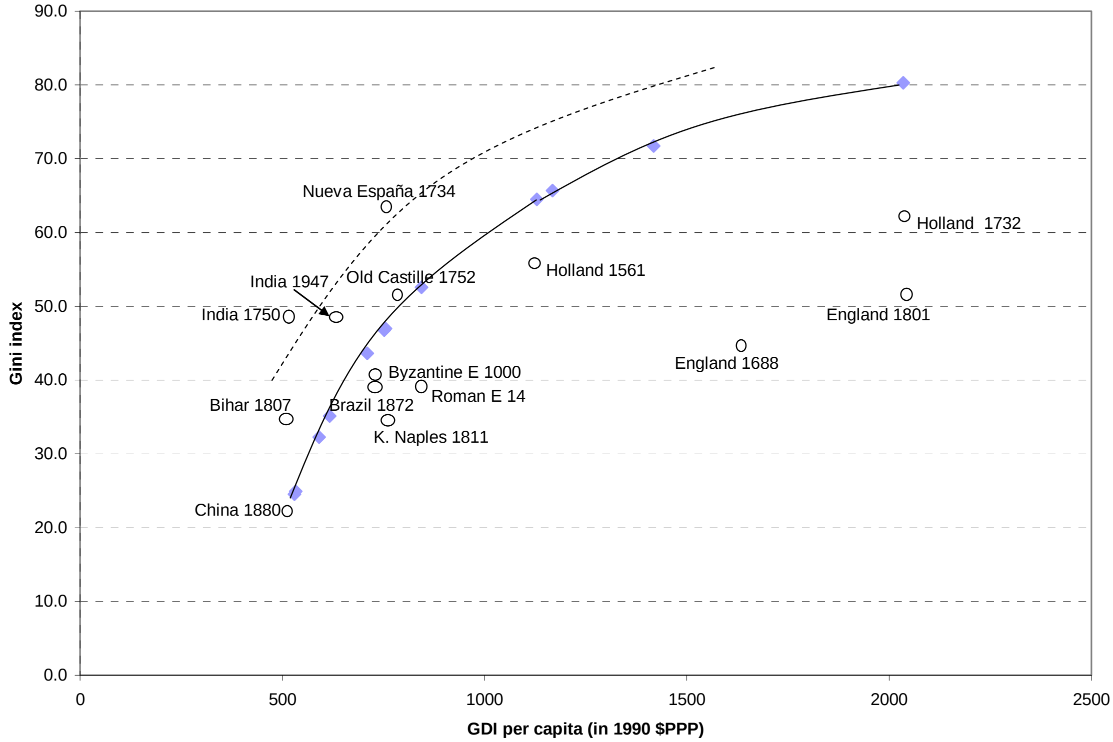
Figure 1

Derivation of the Inequality Possibility Frontier



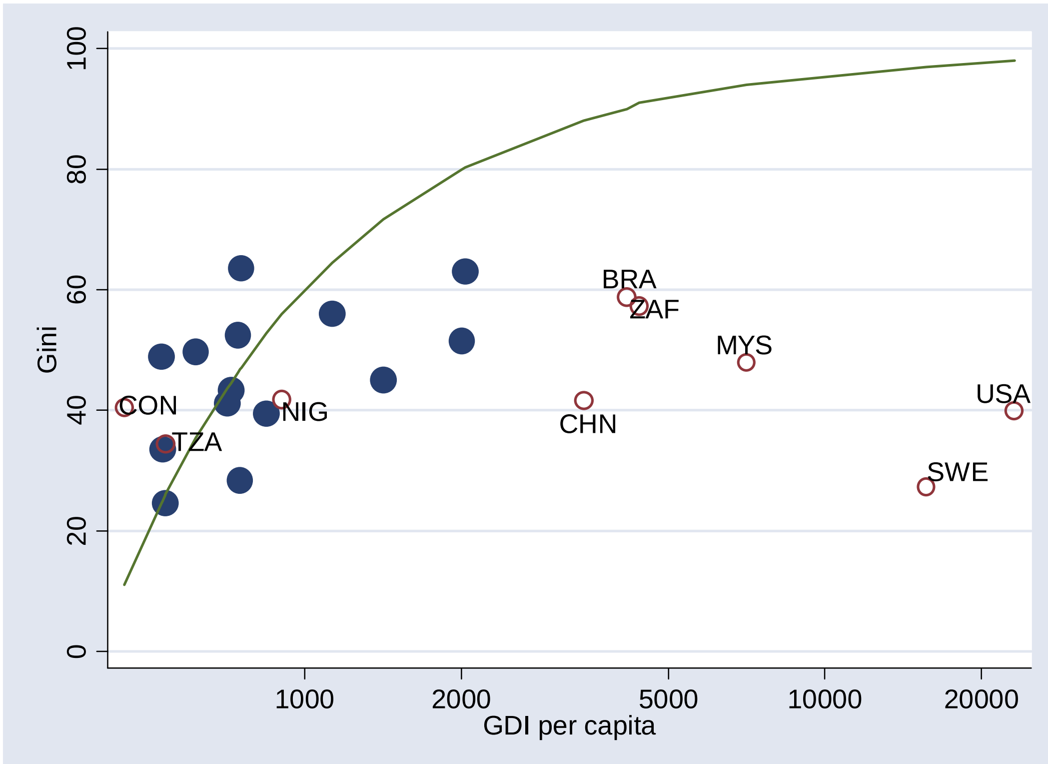
Note: Vertical axis shows maximum possible Gini attainable with a given α.

Figure 2
Ancient Inequalities: Estimated Gini Coefficients, and Two Inequality Possibility Frontiers



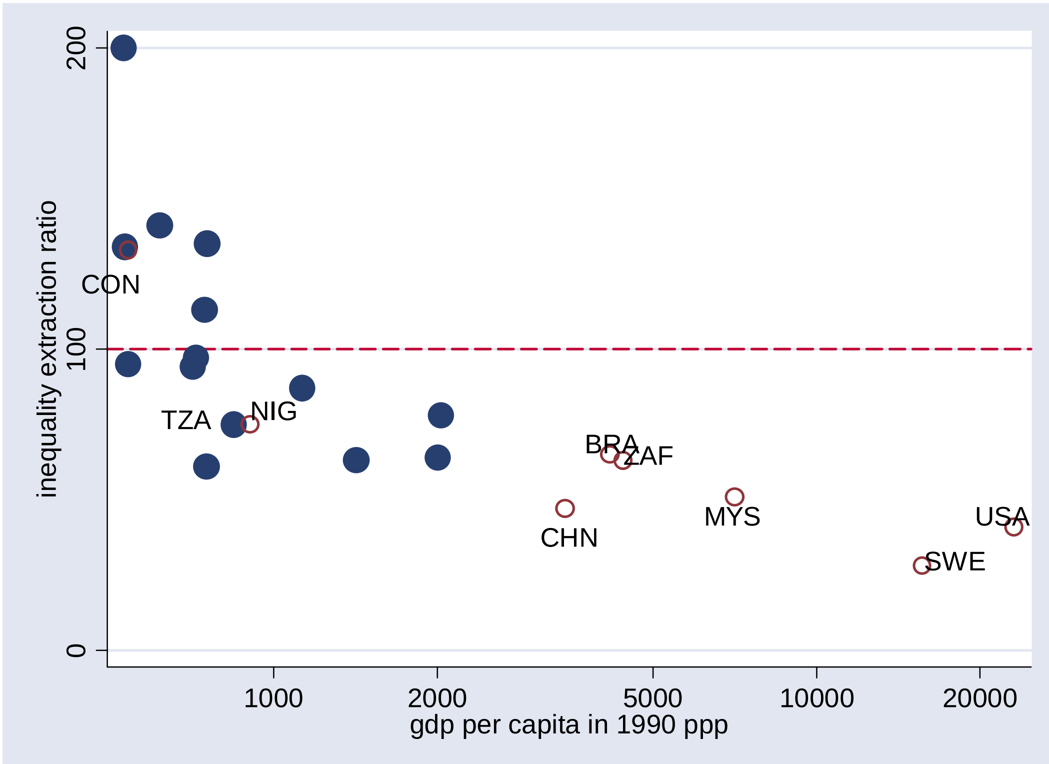
Note: The solid line IPF is constructed on the assumption that s=$PPP400; the broken-line IPF is constructed on the assumption that s=$PPP 300. Estimated Ginis are Ginis2 unless only Gini1 is available.

Figure 3
Ginis and the Inequality Possibility Frontier for the Ancient Society Sample and Selected Modern Societies



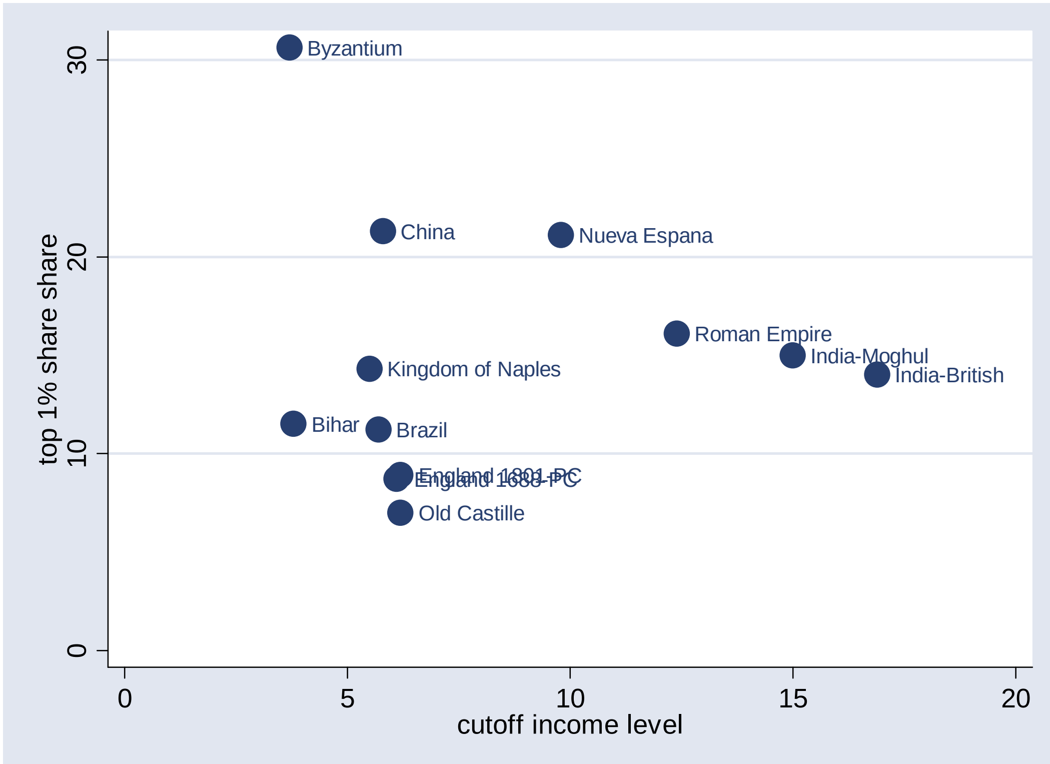
Note: Modern societies are drawn with hollow circles. IPF drawn on the assumption of s=$PPP 400 per capita per year. Horizontal axis in logs.

Figure 4
Inequality Extraction Ratio for the Ancient Society Sample and Selected Modern Societies



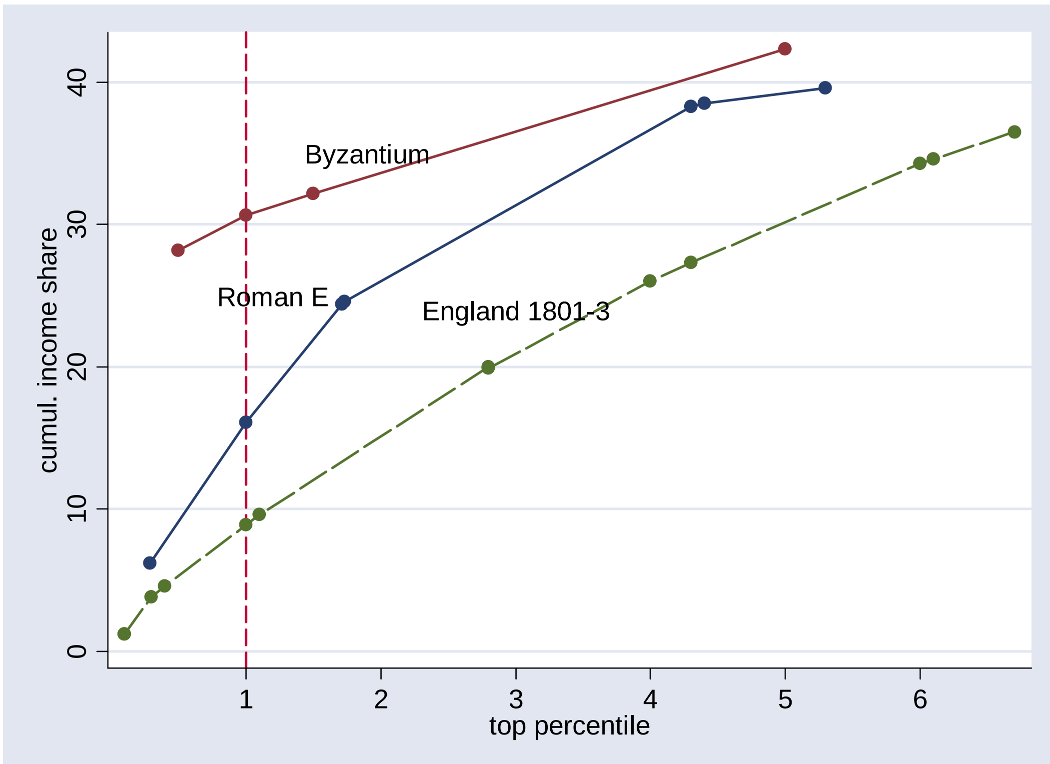
Note: Modern societies are drawn with hollow circles. Horizontal axis in logs. Inequality extraction ratio shown in percentages.

Figure 5. The top percentile's income share and the cut-off income level separating it from the lower 99 percent



Note: The cut-off point is income level, expressed in terms of country mean income, where the top percentile begins. The two data points for England and Wales (1688 and 1801-3) almost fully overlap.

Figure 6. Top five percentiles of income distribution in Byzantium 1000, Rome 14, and England 1801-3



Note: All data points except for the top 1 percent are empirical. The top 1 percent share is derived using Pareto interpolation.

Figure 7. Gini vs the y/w Ratio in an Ancient Sample of Eleven

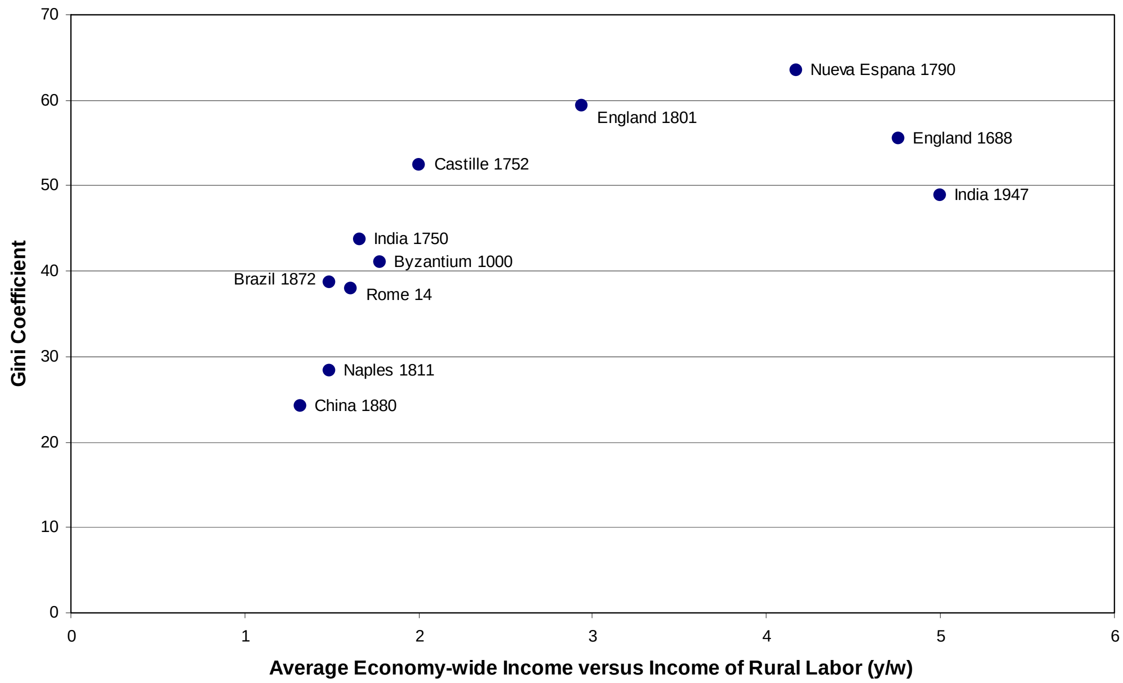


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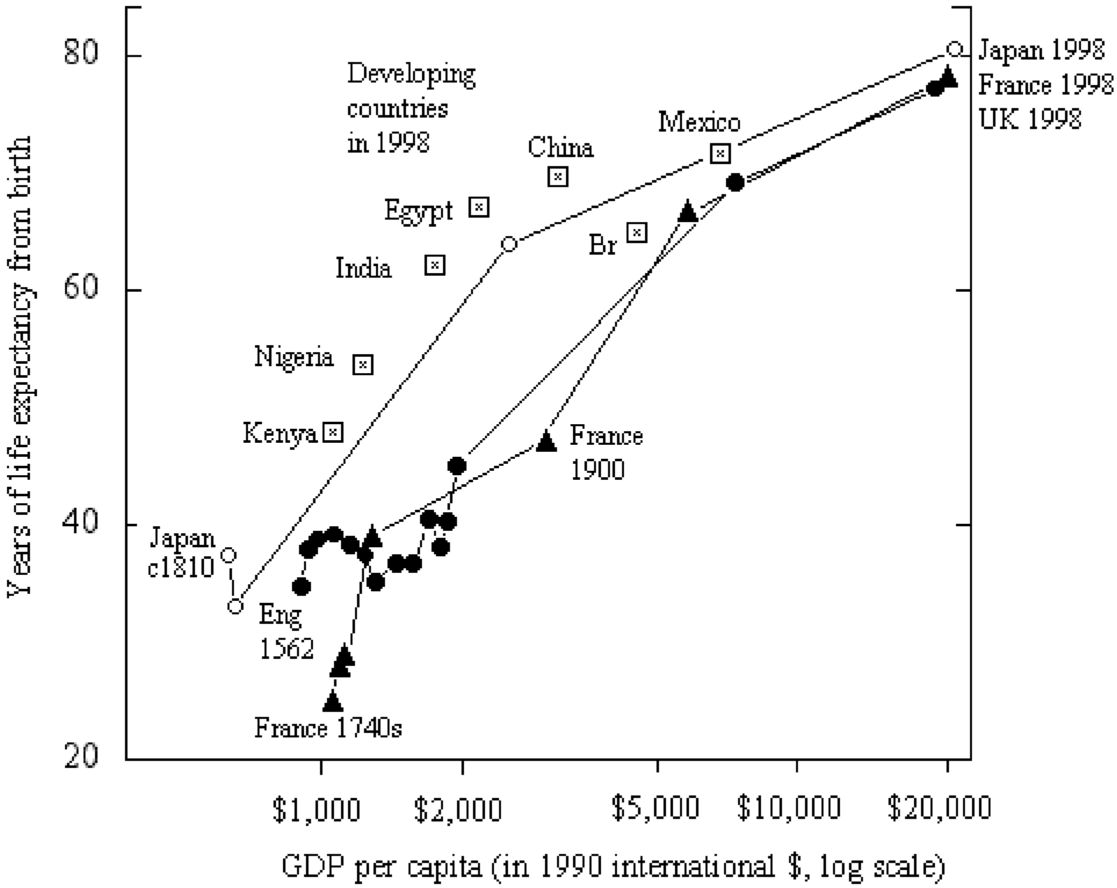
Figure 8. Life Expectancy and GDP per Capita, Long History versus Developing Countries Today



Sources: gpih.ucdavis.edu, Maddison 2001, and
<u>Statistical Abstract of the United States 1998</u>